World Heritage Biodiversity: filling critical gaps and promoting multi-site science-based approaches to new nominations of tropical coastal, marine and small island ecosystems in Latin America and the Caribbean

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1. INTRODUCTION

1.1 Geographic extents and biogeographic division of the Latin American and Caribbean coastal tropical region

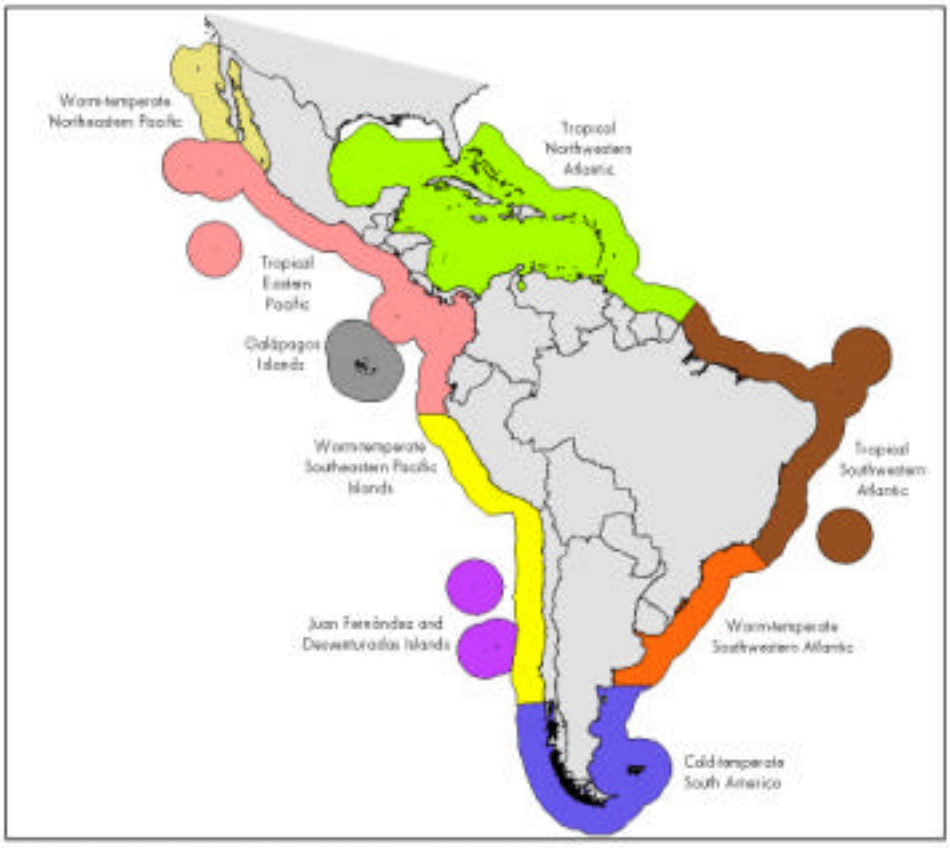
The Latin American and Caribbean tropical and sub-tropical region comprises 44 countries and territories, 27 of which are island-nations or territories. The study area was defined following the biogeographic division recently defined by 26 marine science and conservation experts during a priority-setting exercise for marine conservation investments in the coastal areas of The Latin American and Caribbean region (Sullivan Sealey and Bustamante, 1999). The study area has approximately 12 120 328 km^2 of Economic Exclusive Zone and it extends, on the Atlantic side, from Palm Beach coasts (South Florida), south to Cabo Frio, Brazil (23°S), and in the Pacific side, from a straight line stretching out of Cabo San Lucas (Baja California Sur, (Mexico) to Cabo Corrientes (Jalisco state, Mexico), south to Peninsula Illescas (Peru). The area includes the oceanic islands of Clipperton and Revillagigedo (Mexico), Cocos (Costa Rica) and Galapagos (Ecuador). The area includes numerous nearshore and offshore islands, keys and banks, and extensive deep ocean areas as the Caribbean Basin.

The biogeographic analysis entailed the development of a three-level hierarchy of marine biogeographic areas. The three-level hierarchy, from coarsest resolution to a finest resolution, was as follows:

- Coastal Biogeographic Provinces
- Coastal Biogeographic Regions (or Marine Ecoregions), and
- Coastal Systems

The largest biogeographic unit, the province, has long been the focus of research to delineate and characterize distinct faunal areas. The biogeographic provinces are the product of geological history of the ocean basins and hydroclimate, including global circulation patterns. The experts examined the information available from different biogeographic studies to establish the latitudinal boundaries along the coast of the area. It is known that different taxonomic groups (mollusks, fishes, algae, phanerogams, etc.) have different distribution patterns based on their physiological requirements, and on their migratory capabilities during their adult stages, but also on the patterns of dispersal of eggs and larvae. The division proposed was the result of a comprehensive analysis of these patterns. In addition, a practical

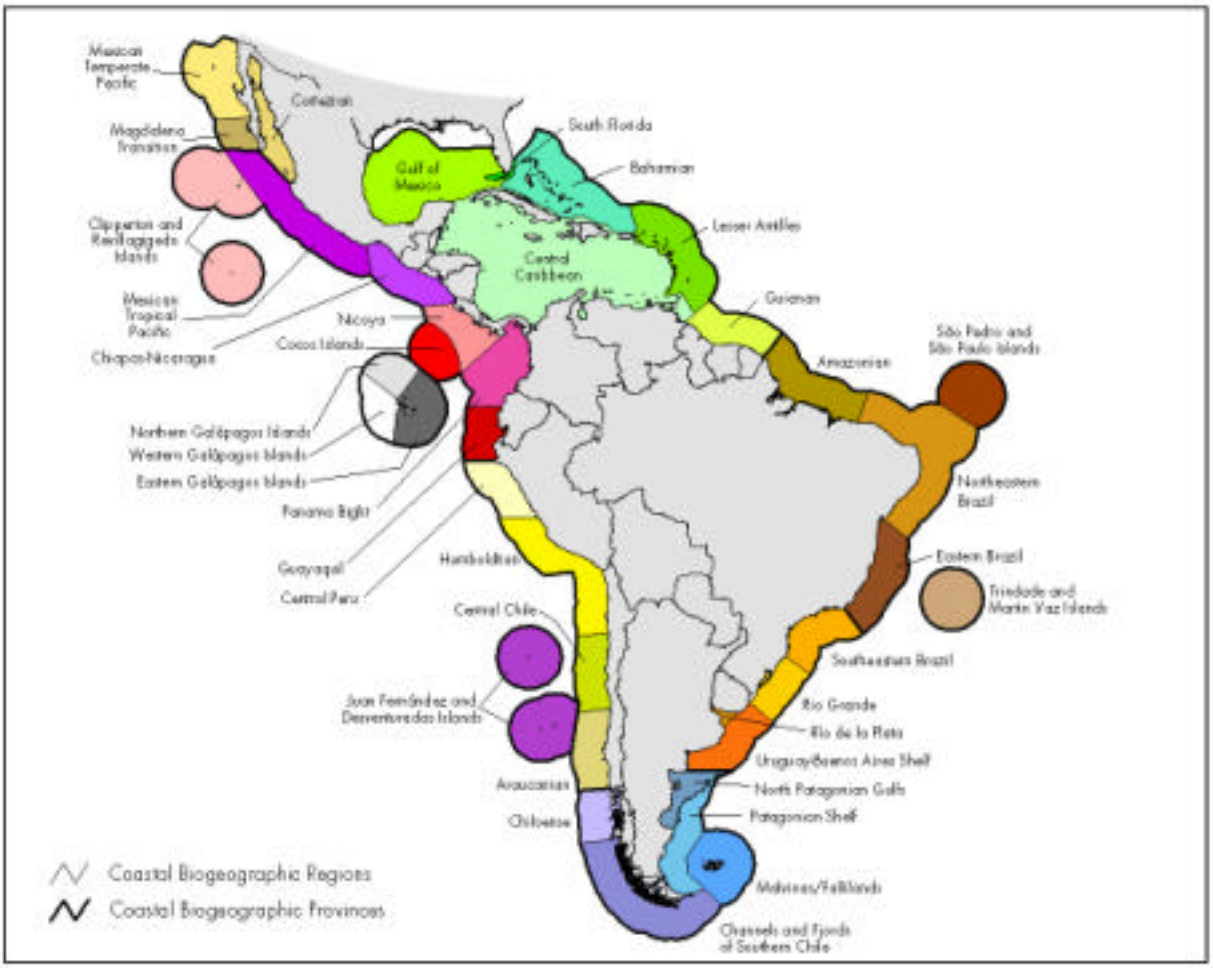
"conservation-related" component was incorporated to the delineation of the outer (which is also longitudinal in the Latin America and Caribbean area) boundaries of the provinces: the outer limits of the Exclusive Economic Zones of each country, i.e. 200 miles off the coast. Although the EEZ as a boundary has little ecological significance, it defines the extent of the nations' responsibility for marine resources management, and allows a consistent mapping representation of coastal features at the atlas scale.



Map A-2 Coastal Biogeographic Provinces of Latin America and the wider Caribbean

As a result of this analysis, 9 "Coastal Biogeographic Provinces" were delineated (Fig. 1), based on ranges of climatic features (basically ocean surface temperature) and ultimately the geographic range of fauna and flora associated to them. Four of the provinces are strictly "tropical" or "subtropical", namely: the **Galapagos Islands**, the **Tropical Northwestern Atlantic**, the **Tropical Southwestern Atlantic**, and the **Tropical Eastern Pacific Coastal Biogeographic Provinces**. The neighboring provinces (the Warm-temperate Northeastern Pacific and the Warm-temperate Southeastern Pacific, on one side of the American continent, and the Warm-temperate Southwestern Atlantic, on the other) are "transition" biogeographic areas where tropical and temperate waters merge to form a much colder environment. In these warm-temperate provinces, a mix of tropical- and cold-originated fauna is found and its geographic range and dynamics are related to the seasonal shift of the convergence zone.

In addition to Coastal Biogeographic Provinces (or provinces), a smaller biogeographic unit or Coastal Biogeographic Region (or Marine Ecoregion) was defined and delineated within each province (Fig.2). The delineation of this unit was a subject of discussion during



Map A-3 Map of study area with Coastal Biogeographic Regions (or Marine Ecoregions)

this exercise since they are more difficult to describe in terms of functionality and discreet boundaries. Their latitudinal boundaries were situated following oceanographic features such as the location and seasonality of convergence zones, the presence of upwelling, the geomorphologic features of the coastal area (narrow versus wide shelves) and the distribution of key biological populations associated to these physical factors (mangroves, coral reefs, some species of algae and fish, etc.).

Considering the nature of this exercise (the selection of conservation areas of outstanding biodiversity value), the biogeographic framework proposed in Sullivan Sealey and Bustamante (1999) was considered the most appropriate for the Latin America and Caribbean region.

An examination of the marine ecosystems covered by these specially protected areas shows the following:

· Two ecoregions (**Galapagos Is. and ad Cocos Is**.) have WHS, although they don't cover the whole ecoregion (i.e. they don't include the EEZ area)

· Three WHS (**Galapagos Is., Cocos Is., Belize Barrier Reef Systems**) are mostly oceanic islands or large coral reef formations: the Belize Barrier Reef System lacks some ecosystems (mangrove, and watersheds) and Cocos Is., lacks the surrounding oceanic waters;

· In four WHS **(Area de Conservación de Guanacaste, Río Plátanos Marine Reserve, Darien National Park, Everglades National Park**) the coastal/marine area that they cover

is mostly wetland, and the adjacent marine ecosystems don't seem to hold potential for expansion as it does not meet the natural value criteria;

· One of the WHS, the Sian Ka'an Biosphere Reserve is not large enough to include nearby critical habitats. Highly developed coral reef formations, fish spawning sites, and seabird nesting grounds are contain in the numerous MPAs (e.g. Banco Chinchorro, Contoy Is., and the National Parks of Cancun, Cozumel, Puerto Morelos, etc.) located along the Caribbean coast of the Yucatan Peninsula.

· One WHS (Desembarco del Granma, in Cuba) was nominated mostly because of its geological value (the marine terraces) and so lacks important adjacent marine ecosystems. There are lush mangrove wetlands and highly developed the spur and groove coral reef formations of Guanatanamo Bay close to the WHS; and the seagass-coral reef-mangrove complexes of the Gulf de Guacanayabo are extensive, including ring-shaped coral reef formations over muddy bottom, unique in the Caribbean.

· Most ecoregions don't have any WHS, and there are very limited numbers of Biosphere Reserves (UNESCO's Man and Biosphere Program) and RAMSAR sites, which are mostly located within the Central Caribbean Ecoregion.

· The WHS are poorly represented in the region.

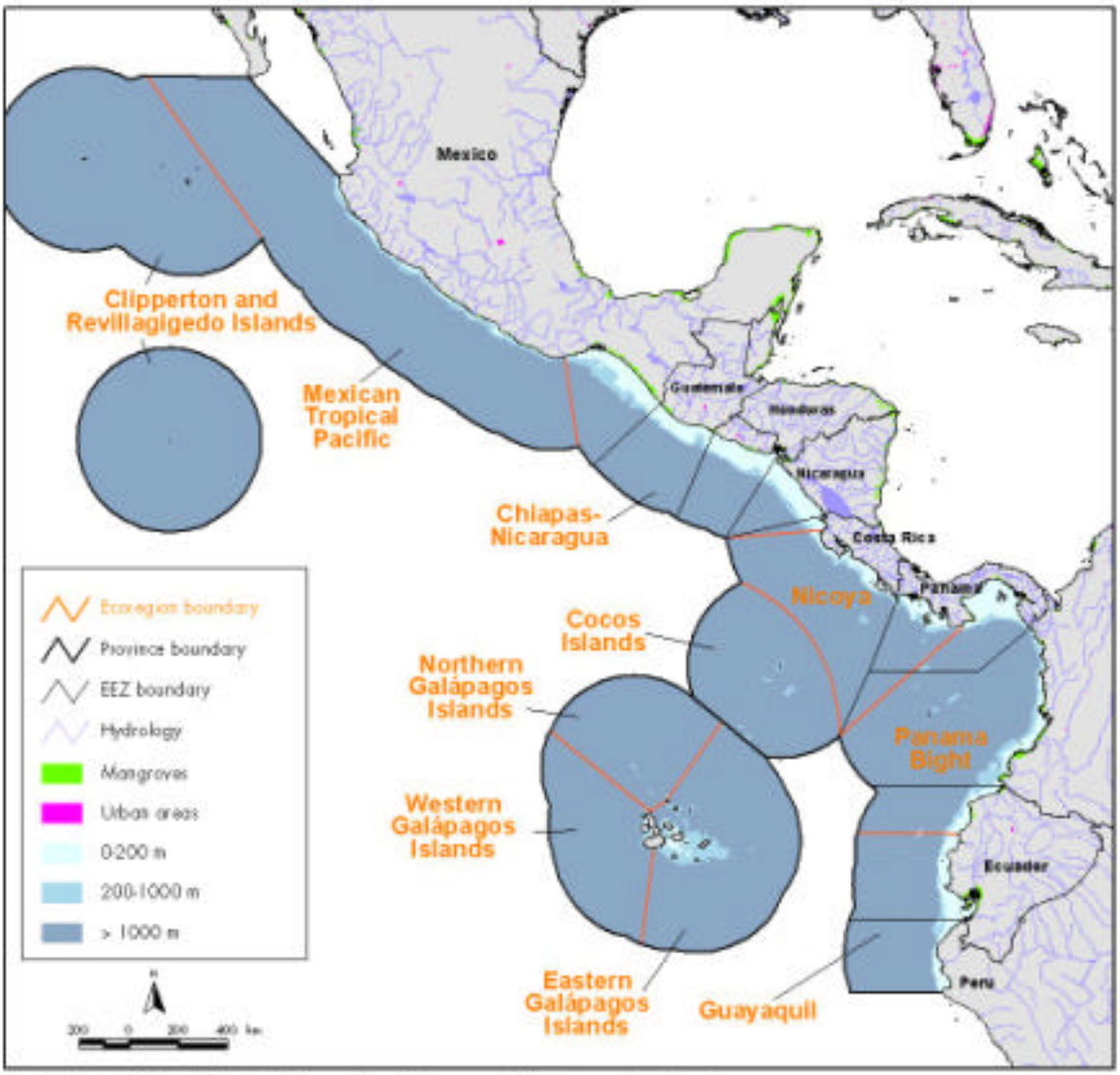
· Pristine areas are not common in the region due, among others, to the following reasons:

  - High population density in many coastal areas, particularly the Caribbean islands;

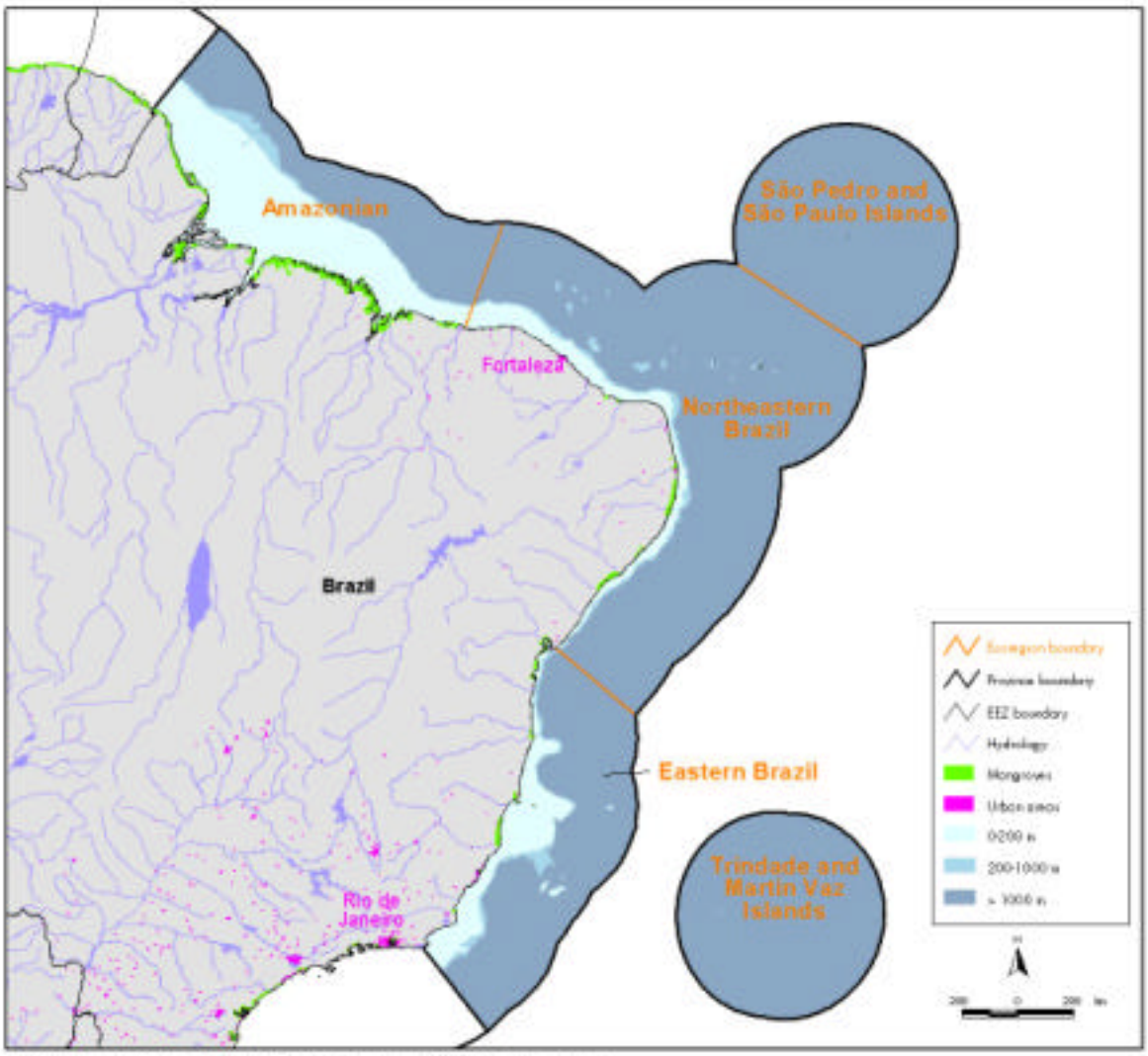
  intense use of marine resources: overfishing and inadequate coastal development (urban settlements and tourist resorts) over the last 20 years have severely impacted some areas that were in pristine conditions or high conservation status years ago. Such is the case of the Caribbean coast of Mexico, many islands of the Lesser Antilles, the mangrove forests of Ecuador and Colombia, and the coastal wetlands of Central America.Despite there still existing areas of notable ecological and conservation value, most of these are not legally protected so there are few opportunities to nominate cluster WHS that are large enough to ensure the ecological integrity of coastal and marine environments.

1.2 Overview of geological and biodiversity values of each province and ecoregion of the tropical and subtropical area of Latin America and the Caribbean

The descriptions of the biogeographic provinces (Fig. 3) and ecoregions (Fig. 4) provided hereafter were taken from Sullivan Sealey and Bustamante (1999). This publication summarizes the geographic and ecological characteristics as well as the conservation status of each of these areas. It is our desire that this information allows the experts to have a quick picture of the biophysical scenario and conservation issues of the Latin American and Caribbean tropical region.



Map A-6 Tropical Eastern Pacific and Galápagos Coastal Biogeographic Provinces and their Ecoregions



Map A-10 Tropical Southwestern Atlantic Coastal Biogeographic Province and its Ecoregions

The Tropical Eastern Pacific Province is the second largest biogeographic province spanning the Pacific coasts of Central America to northern South America. The province area encompasses 3 372 702km_ and is tropical with what are likely the widest range of sea surface temperatures. The province supports tropical communities such as coral reefs with maximum monthly mean surface temperatures to 33^0C, but sea surface temperatures can drop to 15^0C with coastal upwelling. This province is defined by the influence of tropical waters flowing in the North Equatorial current, the Equatorial Counter current, and the South Equatorial current. These systems west from both the northern and southern oceanic gyres as well as complex topography with the intersections of the Cocos Plate, the Pacific Plate and the Nazca Plate. Throughout the entire province, the continental shelf is very narrow, the mapped area is over 95% deep water with depths over 1000 m. The province includes two groups of oceanic islands, and five regions stretching from Mexico to Perú. Mangrove communities occupy a significant portion of the shoreline along the coasts of Central and South America. The Gulf of Panama is one of the most complex in terms of its oceanography, topography and biology. Based on ocean circulation patterns and coastal

geomorphology as well as the distribution of key biological populations, the province was divided into 7 marine ecoregions (2 of them formed by insular groups), namely Clipperton and Revillagigedo Islands, Mexican Tropical Pacific, Chiapas-Nicaragua, Panama Bight, Cocos Islands, Nicoya and Guayaquil. Hereafter, a brief description of each marine ecoregion:

Clipperton and Revillagigedo Is.- composed of an isolated atoll of Clipperton and the small island group to the north, the Revillagigedo Islands are of interest biogeographically because of their isolation and are described as the stepping stone in migration of coastal marine species from the western Pacific to the eastern Pacific. These islands are 1100km from the coast of Mexico as well as over 100km from the furthest islands in the group.

Mexican Tropical Pacific- Includes the Mexican states of Jalisco (south of Cabo Corrientes), Colima, Michoacan, Guerrero and a portion of Oaxaca north of Tehuantepec Isthmus. The mountains of Sierra Madre del Sur occur along the coast except for the lowlands at the Balsas river basin. Offshore, the continental shelf is quite narrow, falling precipitously into the Middle America Trench. Coastal oceanography is influenced by the North Equatorial Current. The area has a relatively dry climate with a coastline broken by 16 coastal lagoon systems stretching along a narrow coastal plain. Mangrove shores occupy about 28% of the whole coastline.

Chiapas-Nicaragua – This marine ecoregions stretches along 2638km of coastline and includes EEZ areas of southern Mexico, Guatemala, El Salvador, Nicaragua and a small part of Costa Rica. The continental platform widens at this region, occupying 29% of the area, steeply sloped in the Middle America. A coastal plain includes seven lagoons, most of them along the Mexican portion in Oaxaca and Chiapas states. There are numerous cliffs along the coast of El Salvador, Gulf of Fonseca, and Nicaragua. Mangroves are extensive and well developed and cover most of the coastline from the northern boundary of the region to south of the Gulf of Fonseca in Nicaragua. This Gulf is one of the most productive coastal systems of the region; however, mangrove forests, which constitute the major habitat for coastal fauna and fisheries, have been degraded for shrimp ponds construction in many areas. Upwelling of colder nutrient-rich waters occurs off Papagayo Gulf, north of the Nicoya Peninsula, originated by Atlantic winds that blow seasonally across the mountains moving surface water offshore. Tropical cyclones originate in the gulf of Tehuantepec area and either move directly westward or follow a northwest course parallel to the coastline.

Nicoya – This marine ecoregion is defined by the presence of the Nicoya Gulf in Costa Rica, and the several bays and gulfs situated southeast to Peninsula de Azuero. The region extends from the Gulf of Papagayo, Costa Rica (at about $11^{0}30'$ N) to the Azuero Peninsula, Panama (at about $80^{0}30'$W), along 2756km of coastline, covering an area of 330 360km_. It includes most of the Costa Rican Pacific area and that off the western half of Panama coast. One fifth of the coastline is occupied by mangroves. Mangrove forests are specially extensive along rivers and estuaries in Costa Rica. This region together with the northern nearby correspond to the Pacific Central America Mangrove Complex defined by WWF. The continental shelf is relatively wide, and includes numerous gulfs, bays, and coves.

A group of eight islands are found in the Nicoya Gulf, **four of which are Biological Reserves,** and the **WHS Guanacaste Conservation Area which includes part of the Papagayo Gulf**. The North Equatorial counter current penetrates the region and splits north and south off the coast of Costa Rica. Despite the discontinuous occurrence and limited development due to upwellings and river drainage, coral formations have been described off Costa Rica and Panama. There are over 40 coral formations off Costa Rica, and the reef communities are richer in the southern portion, although they generally small, and shallow with few coral species. Despite the huge distance between the Central Pacific and the Eastern Pacific, reef faunas are essentially similar. The main coral areas of the Pacific Central America are found off Panama south of Azuero Peninsula and Coiba Island.

Panama Bight – This marine ecoregion has 508 357km_ and stretches along 4227km of coastline (from Peninsula Azuero, at about $80^0$30'W, to Caraquez Bay, Ecuador), and includes three countries: Panama, Colombia, and the northern portion of Ecuador. The Gulf of Panama and the Pacific coast of Colombia form a bight of significant value. This region contains the largest mangrove coverage of the whole province (37%). The ecoregion corresponds to the WWF mangrove units Gulf of Panama and Esmeraldas/Pacific Colombia characterized by red mangrove trees of considerable height (up to 30m). The middle part of the Gulf of Panama ranges 50-100 m depth. Most the coast is flat with several rivers mouths, swamps and mangroves. Extensive flats are found west to the Panama Canal. Cliff dominated coasts with occasional fjords and gorges, are the predominant coastal morphology from the border to Cabo Corrientes, Colombia. From here to the Ecuador border, large mangrove forests and river deltas are present. River discharge affects reef development along Colombia coasts. Every September, young whales (*Megaptera novaeangliae*) visit the area off Tumaco, Colombia. The most important reef formations of the Pacific Colombia are located at the Gorgona and Malpelo islands. Coral reefs are also present along mainland Ecuador. The deltaic-estuarine system of Mataja-La Tola in northern Ecuador has the most developed mangrove forests of the country. Despite the exploitation of mangroves, this area is considered one of the most conserved coastal areas of Ecuador.

Guayaquil – This marine ecoregion extends from the Caraquez Bay by the Equator to Peninsula Illescas, Perú (about 6^0S). The region comprises 263,411km_ of area, and stretches along 2087km of coastline, half of which is occupied by mangrove forests. The Guayaquil Gulf is the main feature of this region. The southernmost extent of the influence of the tropical waters flowing southward, as well as the southern limit of mangroves in continental coasts, is located in Northern Peru. Local currents merge with the northward flowing Humboldt Current and deflect to the west to the Galapagos Islands. In Caraquez Bay, most of the mangrove forests along the estuary have been lost due to shrimp culture facilities. This area, together with the Gulf of Guayaquil, supports abundant shorebird populations. An upwelling area and important pelagic fisheries (mostly sardines, and squid) occur off Machalilla (Ecuador). These populations are the main food source for pilot whales (*Globicephala macrorhynchus*). Marine turtles are also abundant in this area, as well as seabirds. Sea lions (*Zalophus californianus*) and several cetacean species are sighted in and around La Plata island. Terrestrial runoff, coastal morphology, oceanic productivity, and

habitat diversity make the Gulf of Guayaquil the most important coastal area of the ecoregion. The gulf supports an intricate community by providing habitat for abundant populations of fish, birds, reptiles, invertebrates and many other ecological and commercially significant groups. Pond construction, mangrove exploitation, pollutants discharge in the Guaymas river, etc., have severely deteriorated this highly productive environment.

Cocos Islands – This marine ecoregion comprise only 5000 ha of shelf area and is situated about 500km southwest of Costa Rica mainland. They are of volcanic origin and rise from the Cocos Plate. Strong westward equatorial currents wash the islands. Coral formations with high biodiversity are found in this ecoregion.

The Galapagos Coastal Biogeographic Province has an EEZ of 864 646km_. Despite the small size, the Galapagos Archipelago is one of the most charismatic island groups in the world. Unique features make this a special area for terrestrial and marine conservation. The province can be subdivided into three regions (Fig. 3) This province is unusual in that it falls entirely under one national jurisdiction, that of Ecuador.

The archipelago is situated at the equator, between longitudes of 86^0W and 93^0W. The Galapagos is made up of 13 major islands and numerous islets and rocks situated at about 950km west of South America. The islands are volcanic in origin, and are located at the crossing of several ocean currents, warm and cold, from east and west. This peculiarity creates a range of marine habitats.

The South Equatorial Current flows westward and meets the Cromwell Current flowing eastward creating frontal systems around the islands. The Cromwell Current moves across the Pacific just below the surface, typically at depths of 100-400m. When the cooler water of the Cromwell Current is pushed to the surface, the mixing of cool, nutrient rich water with the warmer South Equatorial Current water generates high biological productivity in the waters around the archipelago.

The geographic isolation of the Galapagos combined with unique oceanographic conditions results in high biodiversity and endemism. Abundant populations of fish, whales, dolphins, sea lions, fur seals, sea turtles, and cormorants, the Galapagos Penguin occur throughout the archipelago. Nesting sites for sea birds and turtles are important. The widely distributed green turtle *Chelonia midas* has a major breeding site in the Galapagos. The islands are also home to the only existing true marine lizard of the world, the sea iguana *Amblyrhynchus cristatus*.

The southernmost limit of the coral reef formations along the Eastern Pacific occurs in the Galapagos. Thirteen hermatypic and 32 ahermatypic (30% of them endemic) coral species are recorded for the islands. The black coral *Anthipates panamensis* is endemic. There are also dozens of endemic fish species. Sixteen species of whales and eight species of dolphins occur in the Galapagos province, while two pinnipeds are endemics: the sea lion *Zallophus wollebaecki* and the fur seal *Arctocephalus galapagoensis*. The rate of endemism is high among marine invertebrates.

The most important conservation issues in the area are the decline of black coral due to tourist demand for jewelry, and overfishing, particularly of hammerhead sharks (*Sphyrna*

spp.) and sea cucumber (*Stichopus fuscus*). Asian fishing fleets pose an increasing pressure to fisheries resources. The increasing number of Ecuadorian fishermen migrating from mainland are also a potential threat to marine resources because their artisanal, non-sustainable methods. Seabirds and marine iguanas predators (cats, rats, and dogs) have increased in numbers. Tourist visitation has increased in the last 20 years leading to a corresponding increase in pollution.

There are clear biogeographic differences across regions within the archipelago. These regions vary in size, area of coastline and shelf area. The regional descriptions are as follows:

Northern Galapagos Islands. This region extends around the northern islands of Darwin, Wolf, Pinta, Marchena and Genovesa. The EEZ area of this region covers 226 017km_. The region has the shortest coastline (15km) of the province. There is a 728-km_ shelf area (less than 1% of the EEZ extension), surrounded by warm waters (ca. 280C). True coral reefs are only found in the northernmost islands, Darwin and Wolf, because of the warmer water temperatures.

Eastern Galapagos Islands. This is the largest region, and comprises the coastal area of the islands Santiago, Pinzón, Santa Cruz y Santa Fé, with cooler oceanic waters (ca. 240C). Altogether this group of islands form a 403 591-km_ EEZ, making up 47% of the whole province. This is the region with the largest coastal area (33 067km_) in relation to the whole EEZ extension (8%).

Western Galapagos Islands. These islands (Isabela and Fernandina) are influenced by waters from the Cromwell Current which are even cooler (ca. 140C) associated with a significant upwelling. The coastline is 410km long, and the platform area is 3320km_, which constitutes only 2% of the total EEZ area of the region.

The Tropical Southwestern Atlantic Province exists entirely in one country, Brazil, as it extends from the Brazil-French Guyana border (4ON) to Cabo Frio (23OS) (Fig. 4). The coastline is very long (14 419km) and the ample EEZ (2 999 950km_) has 17% of its area occupied by shelf waters (533 244km_) (Fig. 4). Almost a quarter of the total mangrove area of the study zone is located in this province (30 816km_). The province has a great variety of coastal formations, including the Amazon river and the reefs in the north, to coastal lagoons (and associated barrier islands) and sand dunes and cliffs along the shore.

Climate is typically tropical, with July air temperatures ranging from 25-30^{O} at the northern limit, to 20-25^{O}C in the south. Precipitation is abundant and mean annual rainfall ranges 1000-2000mm in the southern part to 1000-4000mm in the area around the mouth of the Amazon river. The northeast area is dry with 250-1000mm of mean annual rainfall.

The coastal morphology of this large coastal province is diverse and three different sectors can be distinguished: the northern portion dominated by the Amazon river and its sediment and water drainage, the coastal narrow coastal margin fringing the Brazilian shield, and the south dominated by barrier islands and rear coastal lagoons.

From south to north the coastal morphology can be described as follows:

From Cabo Frio, the first major feature is the deltaic protrusion at the Paraiba do Sul river, which is followed by several deltaic river mouths. From 30 to 27^{O}S, the shelf broadens to form the Abrolhos Banks. The Abrolhos Archipelago is settled over a broad bank, and is composed of islets and banks of calcareous reef sandstone that emerged in the Holocene. Most coral species are endemic; some Caribbean species have their southernmost extent here. North of Itacaré the coastline becomes indented with rias and embayments, the largest of which is Todos os Santos Bay. Northward, out of the influence of the Falkland current, the climate is increasingly warm and wet and the estuaries and rias are fringed by mangroves.

North of Salvador Peninsula, the straight coastline is bordered offshore by beach rocks and calcareous reef sandstones, some of them cemented dune sands (eolian calcarenites). Coastal terraces are 2-8m high, and tidal range increases to 3-4m.

Humid tropical conditions dominate the coastline from Recife to Natal (annual rainfall ranges 1000-2000mm). Here the coastal morphology is simple, with beach-ridge plains, nearshore sandstone reefs and some cliff areas. At Calcanhar Cape, the coastline abruptly changes its orientation towards the west-north west, and is dominated by beach ridges and dunes alternated with lagoons, swamps, and salt deposits. The dry season is of greater length.

Tidal range increases westward and the coastline at this equatorial sector is indented with islets and estuaries bordered by mangrove swamps, alternated by small sedimentary rocky-cliffy sectors. The Para and Amazon rivers are separated by the deltaic island of Marajo. Both have intricate channel topography and numerous mangrove-fringed alluvial islands which are highly variable in configuration due to the interactions of waves and tidal-fluvial currents.

The massive drainage of water and sediment from the Amazon produce an accretion at the coastline, especially northward, as the result of tidal movements of the alongshore Guiana current. At this sector, climate is perennially hot and wet, with more than 2000mm of annual rainfall and luxuriant vegetation. Coastal waters are turbid due to sediment suspension. The discharge of the Amazon river strongly influences the quality and quantity of the coastal flora and fauna. In the rest of province area, the oceanographic conditions are determined by the presence of the Brazilian (flowing southward) and the Guianan (flowing northward) currents. Both are originated from the branching of the warm South Equatorial Current, which flows westerly from the Atlantic Ocean.

Biodiversity and productivity in the coastal ecosystems of the Tropical Southwestern Atlantic are highly influenced by the nourishment coming from the terrestrial runoff. Therefore, main areas of high productivity are associated to estuarine and mangrove formations.

More than thirty species of marine mammals are reported to occur in the Brazilian waters. The southernmost limit of the Antillean manatee *Trichechus manatus* is currently situated at northeastern Brazil as far as the Bahia State. The Amazonian manatee (*T. inunguis*) is also found in this area. Thousands of green turtles (*Chelonia midas*) are reported to nest along the coastline from Maranhao to Espirito Santo States. The other 4 species of turtles also occur and nest in some areas of Brazil. Fisheries resources have been intensively exploited, and overfished in most cases.

Five marine ecoregions (three at the continental shelf, and two around offshore islands) were identified within this province, as follows:

Amazonian. Northern limit: French Guiana (4^{O}30'N); southern limit (3^{O}S): Parnaiba River. Coastline length: 10,252km; EEZ area: 556,062km_. Over a half of this area is occupied by continental platform area (211,194km_). Mangroves cover 23,6761km_ along 6301km of coastline. They comprise 77% of the total mangrove area of the Province. Extensive pristine mangroves, numerous large river discharges (Amazon), broad shelf, humid tropical climate, coastal geology of Pleistocene origin, and sedimentary formations are the main coastal features of the region. Large quantities of sand, silt and clay are accumulated along the shore. The Amazon delta forms a huge system of inlets, islands, mangrove forests, brackish lagoons and swamps that provide shelter, nourishment and breeding habitat for fishes, invertebrates and shore birds. The large wetland, mangroves and estuaries at the Maranhao (Sao Luis) Gulf constitute the habitat for over one hundred species of shorebirds. Here, extensive dune formations associated with lagoons extend several kilometers inland. The Maranhao entrances and lagoons (Reentrancias e Lencois Maranhensis Conservation Area) is located in this area. This ecoregion corresponds with the Brazilian portion (units 11c-e) of the Amazon-Orinoco-Maranhao Mangrove Complex delineated by WWF. The shelf platform is relatively smooth. Primary production is relatively high; levels of suspended materials are high. The ocean circulation is dominated by the northerly-flowing warm Guiana Current. Benthic communities are rich and pelagic biota is relatively scarce. Depositional and erosional processes are extremely influential. This ecoregion includes a notable submerged bank (Manuel Luis).

Northeastern Brazil. Northern limit: Parnaiba River (3^{O}S); southern limit: Salvador (13^{O}S). This is the largest region of this province, with 2106km of coastline, fringed by 355km of mangroves covering 3904km_. The total region has a 1,043,712km_ area (35% of the whole province), 100 613km_ of which are occupied by shelf waters, including the insular platforms of Atol das Rocas (an atoll) and Fernando de Noronha Islands. This is the driest area of Brazil, with 250-1000m of mean annual rainfall. The coastal morphology is characterized by an indented coastline of calcareous origin, with dunes and some mangroves. This Region corresponds with Units 12a-b of the Northeastern Brazil Mangrove Complex delineated by WWF. Some reefs and many banks are found off the northern sector with substantial presence of macrophytes up to the 10-meter depth. Coastal lagoons dominate the southern portion of the region. Primary production is extremely low due to limited nutrient input from the lack of rivers, and the low-productivity influence of the oceanic current. Rivers are typically coastal in origin, not draining from inland. The northern portion has some ephemeral rivers with seasonal discharge. The Sao Francisco is the major river system. Water temperature and salinity are high. Limited thermoclines constrain nutrient turnover and availability. The warm South Equatorial current impacts the continent near Natal and splits into a southerly and westerly branches. The Archipelago Fernando de Noronha and Atol das Rocas, are situated off the Calcanhar Cape. The latter lies about 200km northeast of the coast of Rio Grande do Norte State. It is an almost circular atoll reef. The former is a volcanic archipelago of one principal 17-km_ island and 18 islets, lying 350km northeast of Cape Sao Roque. Both Archipelagos have a similar flora and fauna and lie on the same continental

platform. Atol das Rocas is known for its abundant seabird nesting colonies and great variety of marine fauna. Fernando de Noronha Archipelago is an important habitat for dolphins. The mangroves in the region are in relatively stable condition.

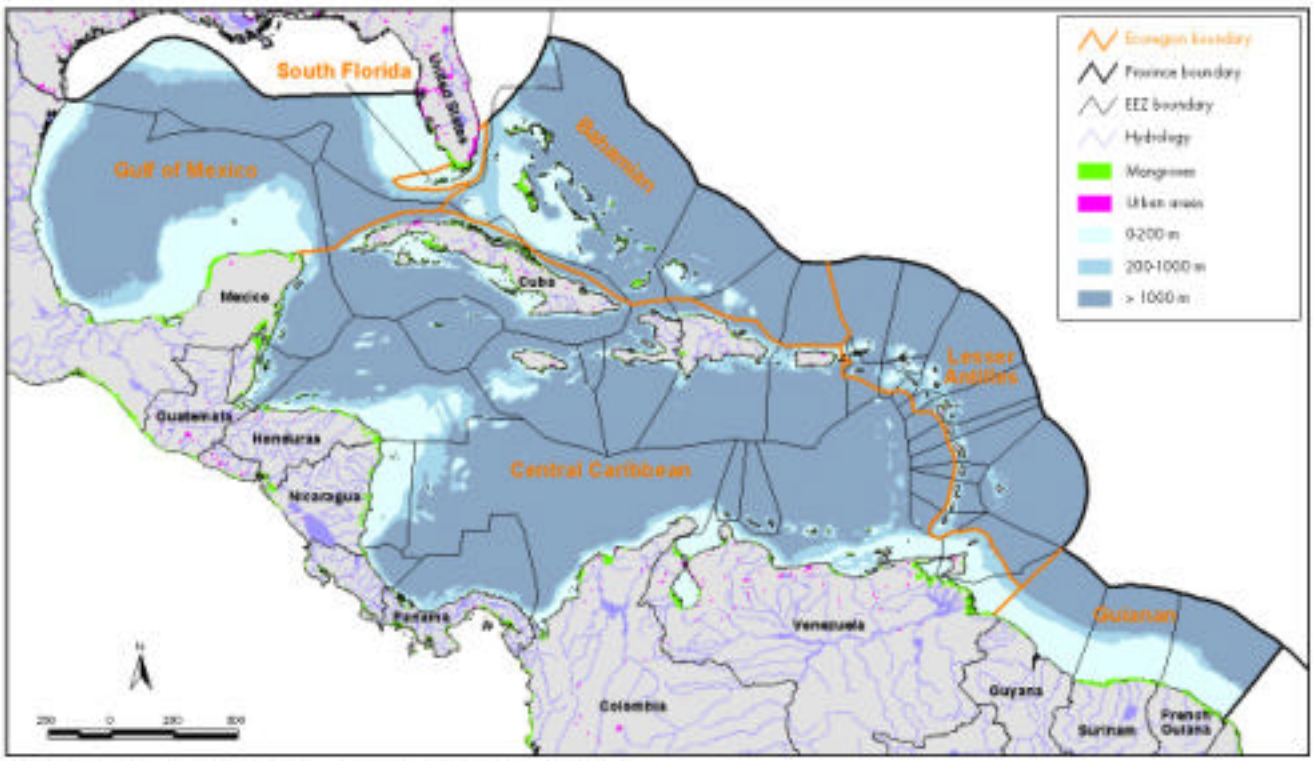
Sao Pedro and Sao Paulo Islands. At 1^{O}N. These small islands, with just 12km of coastline, are situated in the Atlantic Ocean, at about 500km northeast of Fernando de Noronha. Both islands are influenced by the northern boundary of the North Equatorial current. The islands have a narrow shelf surrounded by deep ocean waters with typical pelagic species (tuna, etc.).

Eastern Brazil. Northern limit: Salvador (13^{O}S); southern limit: Cabo Frio (23^{O}S). This region is characterized by tropical forests and restingas close to land masses. Shelf is mostly broad (121 244km_, 24% of the region area) but gets narrower in the northern potion. The coastline length is similar to that of the Northeastern Brazil, and stretches along 2050km. Seven percent (504km) of the coastline is fringed by mangroves, which cover 3215km_. Well developed biogenic formations rest on a volcanic substrate. Coastal sediments are highly variable, with granitic and gneiss components. Macrophyte banks are common throughout the region, to a depth of 10m. This Region corresponds with the Unit 12c of the Northeastern Brazil Mangrove Complex delineated by WWF. Several important rivers drain into this region. Water circulation flows southwesterly due to the presence of the tropical, nutrient-poor Brazilian current. Temperature gradients become influential near Cabo Frio and an important upwelling occurs here. At Cabo Frio, the Brazil current changes from a southerly to southwesterly direction. The Archipelago de Abrolhos is an important area for humpback whale breeding and calving. The southernmost limit of Caribbean coral species occurs here. Mangroves are in Endangered conservation status.

Trindade and Martin Vaz Islands. At 20^{O}30'S. Volcanic islands, influenced by Brazil current returning to the deep Atlantic, form the furthest extent of a submarine mountain range extending out from the coast. These small islands (total coastline length about 8km) with a very narrow shelf (30km_) are relatively unknown.

Tropical Northwestern Atlantic Province (TNWA) is the largest province in the western hemisphere and extends from the tropical waters of the Gulf of Mexico and South Florida to the French Guiana-Brazil border (Fig. 5). The province popularly referred to as the "wider Caribbean", encompasses a complex tropical area of shallow seas, banks, atolls, continental, and island coastlines. I**t** is most known for the extensive coral reef development, both fringing coastlines and at shallow platform margins (barrier reef systems).

This province is remarkable for a number of reasons. It is the largest province overall, at 5.7 million km_, and encompasses more than 28% of the entire study area. It has the largest area of shallow coastal shelf, both by percent area of the province, as well as total area. It has the largest number of islands and largest island area within a province as well as the most diverse and largest inclusion of enclosed seas, bays, and gulfs.



Map A-11 Tropical Northwestern Atlantic Coastal Biogeographic Province and its Ecoregions

The entire province extends from the northeastern corner of Brazil to the coast of east Texas and then to south Florida. The area includes not only shallow water resources, but also several large deep basins included within the Caribbean Sea and the Gulf of Mexico. The ecoregion is tropical in surface water temperature, with monthly means ranging from 24-31°C. The average surface temperature is 27°C typically with about 4°C annual variability.

The oceanography of the province is dominated by western boundary currents of the Atlantic that span a scale of thousands of kilometers. The Equatorial Current of the Atlantic turns north at the coast of Brazil and becomes the Guiana Current, running offshore to the eastern Venezuelan shelf. At the shelf, mixing with the vast effluent of the Orinoco River, the current runs to the west and north through the Caribbean Basin, forming the Caribbean Current. Part of the Equatorial Current remains windward of the Lesser Antilles and later the Bahamian Archipelago to form the Antillean Current. Waters that have moved west and north through the Caribbean, up the coast of Central America, and through a “loop” in the Gulf of Mexico, funnel abruptly back to the east through the straits of Florida.

Antillean Current and Florida Straits water combine to form the powerful Gulf Stream moving up and across the northern Atlantic. This large-scale gyre moves water clockwise through the northern Atlantic and carries warm tropical water from the equator throughout the province to exit at the Gulf Stream. This general circulation pattern found throughout the province controls macro-scale phenomena such as

propagule distribution and climate. The large-scale features are generally well understood. Deeper water circulation is restricted by shallow sills between the deeper basins; throughout the area, an average ocean depth is recorded at almost 2,200 m, with a maximum depth in the Cayman Trench of 7,100 m.

The marine resources of this province include coral reefs, mangroves, seagrass meadows, and tropical coastal fisheries. The most important commercial fisheries throughout the entire province are spiny lobster, reef fish (snapper and grouper), shrimp, and queen conch.

Six ecoregions were described in this province (Fig. 5) based on the faunal distribution of stony corals, octocorals, and fish (Sullivan Sealey and Bustamante, 1999). They represent ecoregions in which unique species for the province occur or species occur in different communities or abundance.

Guianan. This eastern-most ecoregion consists entirely of the dense mangrove coastline of Guyana, Surinam, and French Guiana. The ecoregion itself is small, with 384 000 km_ or 7% of the total province, but accounts for 11% of the total mangrove area. The area is characterized by an absence of carbonate geology and a wide coastal shelf consisting primarily of soft mud-bottom communities. It is dominated by the northern flow of the Amazon River plume. There is limited reef development, but important fisheries resources exist in the marine and estuarine systems.

The natural communities are relatively unknown It is undoubtedly the most unique of the ecoregions and, located east of the Orinoco River delta, may have the least faunal similarities to other ecoregions in the province.

There are few documented conservation threats to this ecoregion, though there are signs of increasing development pressure, oil drilling, timber concessions, and mangrove removal.

Lesser Antilles. The Lesser Antilles ecoregion includes a relatively small landmass, consisting of small islands from Culebra Island, off Puerto Rico to the Grenadines to Grenada. The oceanography and coastal processes associated with a broad coastal shelf and soft-bottom benthic communities separate Trinidad and Tobago from the Lesser Antilles. The Lesser Antilles ecoregion consists of small volcanic and carbonate islands and banks covering 689 000 km^2, or 12% of the total province. The climate is marine tropical with pronounced wet and dry seasons. This ecoregion has the smallest area of mangrove coastlines, though many of the original fringing mangroves of these islands were likely removed during the more than 400 years of post-Columbian settlements. Therefore, mangrove communities are relatively small and are either a narrow fringe or associated with the mouth of small rivers and streams.

The islands have traditionally been divided into the northern Leeward Islands and the southern Windward Islands, an historical designation relating to the ability of sailing ships to travel between the islands. All islands of the ecoregion are exposed to the northeast trade winds with high wave and wind energy from the western Atlantic. They vary in size from relatively small islands of only a few thousand square

kilometers, such as St. Maarten and St. Barthélémy, to the largest island of Guadeloupe with 63,020 km_. For some island nations, the area of reefs and banks is equal to or greater than the area of land. Reef fish populations have been over-exploited for years. Large populations on small islands have looked to coastal pelagic fisheries such as flying fish, dolphin (mahi mahi), and tuna as relatively new fisheries resources.

The reef resources have been well documented by local marine laboratories. Coastal resources have been described by country for Puerto Rico (Culebra), U.S. Virgin Islands, British Virgin Islands, Anguilla, Antigua and Barbuda, Nevis and St. Kitts, St. Maarten, Saba, Dominica, St. Vincent, St. Lucia, Barbados, the Grenadines, and Grenada. The large number of countries and territories with jurisdiction over the marine resources of this ecoregion makes it difficult to produce a regional synopsis. Countries vary in their ability to collect and track long-term information on the status of marine resources; there is no regional scientific institution that could provide technical assistance for all the island nations.

The island economies are typically based on small-scale agriculture and tourism with relatively little industrial development. Sugarcane and bananas have been the historically important crops. The cultivation of sugar cane creates associated problems of fertilizer and pesticide usage as well as pollution from mill processing, all of which can present a threat to nearshore marine communities. Runoff and dumping of wastes in the ocean can have long-term impacts to coastal systems. The growth of tourism has spurred a boom in coastal development for resorts and cruise ship ports.

The issues associated with declining catch per unit effort and loss of fisheries revenue have been discussed locally by a number of countries. Attempts have been made to examine the utility of marine fisheries reserves (e.g. St. Lucia, St. Croix), small-scale aquaculture of invertebrates or macroalgae as well as alternative fishing methods to improve the catch and profitability of fishing.

The small size of these islands and the pressures of growing populations that may depend on growing port and transportation infrastructure to support tourism, make for a very vulnerable marine conservation setting. The challenge is to balance the growth needed for economic development with the need to maintain a high level of environmental quality in coastal waters. Coastal systems are, after all, the very commodity tourists are coming to experience.

Bahamian Archipelago. This ecoregion includes carbonate banks and islands stretching more than 3 200 km from Little Bahama Banks to the north to Navidad and Silver Banks to the south. Three countries have jurisdiction over this area: the Bahamas and the British colony of the Turks and Caicos occupy most of the 823 000 km_, while the Dominican Republic claims jurisdiction over the La Plata and Navidad banks to the extreme southern end of the archipelago. The archipelago is made up of a relatively young carbonate bank system dominated by the lithogenic and biogenic production of calcium carbonate sediments. There are more than 1,300 small islands and cays, only a handful occupied, with two large population centers—Nassau and

Freeport in the Bahamas. Though the total population is less than 350 000 people, more than half that number resides in Nassau.

The climate is subtropical in the northern Bahamas with a noticeably cooler and drier winter season, but becomes distinctly tropical and dry in the southern Bahamas and Turks and Caicos Islands (e.g. less than 750 mm rain per year). The Bahamas represents the most popular tourist destination in the province outside of Cancún, Mexico—the province's mega-resort destination. American tourists are attracted by the proximity, ease of travel (especially by cruise ship), beaches, yachting, and fishing. A strong commercial and recreational fishing industry exists in both the Bahamas and the Turks and Caicos.

Rocky shores and beaches on windward exposures and mangrove forests to the leeward side of the islands dominate the low-relief coastlines. The mangrove lagoons and bays dominate much of the actual land area, particularly on large islands such as Andros. Mangroves are critical coastal nursery areas for recreational fishing target species such as tarpon, bonefish, and permit. The mangrove trees themselves can be structurally small and sparse in the extremely oligotrophic coastal environment. There are no large riverine systems on these carbonate islands.

Fisheries resources are abundant throughout the archipelago. The area of shallow water bank is large in comparison to the overall land area. Historically, fishermen have exploited sponges, finfish, lobster, turtles, and conch. Most fishermen focus on spiny lobsters, the highest cash value species. Recreational fishing attracts anglers from around the world for coastal pelagics, reef fish, and gamefish that are caught and released.

This ecoregion can be considered the most pristine in the province, but this word should be used with caution. The resources are certainly not "pristine" in terms of intact ecological systems, but rather the ecoregion reports no collapsed fisheries. Grouper and snapper still dominate the finfish catch. The threats are essentially the same throughout the province, but vary greatly with location within the ecoregion. Growing population centers in Nassau, Freeport, Marsh Harbor, Georgetown, and Providenciales are experiencing rapid degradation of coastal water quality and destruction of coastal habitats. Mangroves are almost systematically cleared in an attempt to make way for waterfront access and to control mosquito populations.

In populated areas, there are early indications of water quality changes such as small-scale fish kills, reports of seafood poisoning, and loss of seagrass communities near developed shoreline areas. The potential threat of overfishing exists, though there is a growing awareness of the importance of enforcement of existing regulations on gear, closed seasons, and size limits.

South Florida – This ecoregion represents the smallest and perhaps most unique of the ecoregions within the province. This ecoregion is part of the continental United States and represents a faunal transition area with elements of tropical, subtropical, and temperate faunal assemblages. The area is only 23 600 km_ and less than 1 % of the entire province area, but is an important mosaic of natural

communities, ranging from hard-bottom communities off the east coast of Florida to Florida Bay to the atolls of the Dry Tortugas.

Throughout this ecoregion, there is intensive management of shallow-water marine resources in the following protected areas:

· National parks that include Everglades National Park, Biscayne National Park, Dry Tortugas National Park, and Rookery Bay National Estuarine Research Reserve;

· Florida Keys National Marine Sanctuary, which oversees the protection of most of the shallow-water communities, including the Florida reef tract in the Florida Keys;

· Bays and beaches adjacent to the large urban centers of Miami and Fort Lauderdale, which are under aggressive surface water improvement programs; and

· Smaller parks and aquatic reserves in Florida that protect nearshore marine communities.

The South Florida ecoregion includes diverse biotic elements with tropical, subtropical, and temperate affinities. Florida is downstream from the rest of the Tropical Northwestern Atlantic and receives propagules from many of the tropical reefs, seagrass beds, and mangrove bays to the south. However, recent oceanographic research findings have shown that larvae produced in the Dry Tortugas spawning grounds may recruit along the Florida Keys and even in the South Florida coast. Diversity also comes from the northwest in the Gulf of Mexico and from the eastern seaboard of the Atlantic coast of the U.S. Endemism is relatively low in South Florida, but there is an extremely high number of species for many taxa groups. Marine and estuarine species occupy habitats from full-strength seawater to oligohaline or freshwater lenses in the numerous mangrove creeks. For example, there are more than 200 recorded fish species that represent unique continental U.S. populations, but only two endemic species.

The manatee population is the largest of the province and stretches throughout the east and west coasts of the Florida Peninsula. Manatees are under increasing pressure from coastal development which threatens the species with toxic algal blooms and increased boat traffic. There are many important coastal systems within the ecoregion that are critical to the life history of commercially targeted marine species. Florida Bay is a large triangular marine lagoon that includes shallow mud banks and deeper seagrass-carpeted basins. The bay receives a portion of the drainage from the large drainage basin of the south-Central Florida Peninsula (Kissimee River-Lake Okeechobee-Taylor Slough). The bay and its associated mangrove creeks are nursery areas for important reef fish such as gray snapper, as well as valuable gamefish like tarpon, permit, and spotted sea trout. These same areas are also the critical remaining habitat of the American crocodile in the U.S. The Dry Tortugas, located at the western edge of the ecoregion, represent an important stopover point for many migratory bird species, including nesting colonies of brown noddies and sooty terns. There are at least four species of sea turtles that use the carbonate beaches of the Dry Tortugas for nesting, an activity that is well protected within the park's boundaries.

The ecoregion can be characterized as both intensively used and intensively managed. Institutionally, there are three separate foci in the management of marine resources and coastal systems: management of fisheries by the appropriate management councils and agencies; management of water quality and wastewater treatment issues by the county and state with federal oversight through the Environmental Protection Agency; and management of coastal development and population growth within the counties by local county and state governments. With this intensive management of specific threats, there appears to be no overall management entity addressing system-wide carrying capacity. Tourism and trade within the ecoregion continue to grow as agencies and conservation organizations race to secure lands into public ownership to prevent future development. For example, the effort to restore hydrological cycles in the Everglades includes buying back land from agricultural use and restoring the area to natural vegetation and community types.

Gulf of Mexico. This ecoregion is the second largest ecoregion, covering 193 000 km_ and 21% of the entire province. The ecoregion represents a continuum of soft-bottom coastal lagoons and shorelines stretching from the northeastern tip of the Yucatán Peninsula, around the Gulf of Mexico to the Texas border and including the Texas Flower Garden Banks and Florida Middle Grounds. This ecoregion is bounded to the north by the temperate coastal systems of the Gulf Coast states of the U.S. (Texas, Louisiana, Mississippi, Alabama, and the Florida panhandle).

The ecoregion has very diverse systems including the reefs and hard-bottom communities of the Flower Garden Banks and the Florida Middle Grounds. The Flower Garden Banks are in U.S. waters and are designated as a National Marine Sanctuary. Here, there are deep coral banks with no emerged islands. The Florida Middle Grounds represent the wide coastal shelf area off the West Coast of Florida. These low-relief hard-bottom areas are important to Florida's recreational and tourist fishing industries.

The Mexican components of the Gulf of Mexico ecoregion are quite different. The Gulf's extensive coastlines can be broken into three sections: Tamaulipas, Veracruz to Campeche, and Yucatán to the east. The Tamaulipas section of the Gulf extends into the southern tip of Texas and includes large coastal lagoons and bays. It contains important nesting beaches for the Kemp's Ridley turtle, as well as offshore soft-bottom communities that have supported a trawl fishing industry for shrimp.

The coast from Veracruz to Campeche is likely the most affected within the ecoregion. The area's largest port, numerous oil drilling platforms, and point sources of industrial waste are all situated here. Contamination of groundwater and drinking water supplies has already posed a health problem for both people and livestock, while coral reefs off Veracruz have been described as severely degraded.

The Yucatán Peninsula and Campeche banks represent one of the most productive fishing grounds in the province. The fishery for red grouper is managed between three countries: Cuba, Mexico, and the United States. This area is developed

for tourism. There is a faunal break point to the east, just north of Cancún. Cancún and the coast of Quintana Roo fall in the Central Caribbean ecoregion.

Throughout the ecoregion, there are significant land-based sources of pollution stemming from industrial wastes, oil terminals, and oil exploration. The United Nations Environment Programme (UNEP) reports this ecoregion as having the highest load of land-based sources of pollution, from petrochemicals to organic nutrients (phosphorus and nitrogen). There are important commercial fisheries for octopus, red grouper, and other finfish that are managed with size and gear limitations, as well as closed seasons for reproduction.

In all likelihood, fisheries are severely affected by loss and degradation of coastal habitats and nursery areas. There are initiatives to protect large coastal lagoon systems, but regional pollution issues have yet to be addressed.

Central Caribbean- This is the largest and most complex of the ecoregions in the TNWA. The ecoregion includes both continental and insular systems surrounding the Caribbean Sea. The ecoregion occupies 46% of the total area of the entire province with 419,554 km^2 of shallow banks and coastal shelf. Jurisdiction over the area is shared by Venezuela, Aruba, Curaçao, Bonaire, Colombia, Panama, Costa Rica, Nicaragua, Honduras, Guatemala, Belize, Mexico (state of Quintana Roo), Cuba, Haiti, Jamaica, Trinidad and Tobago, Puerto Rico, the Dominican Republic, and the Cayman Islands. As a pattern, the islands have higher coastal population densities than continental areas. There is a wide disparity of wealth throughout the ecoregion, from very poor (such as Haiti) to relatively rich (such as the Cayman Islands and Aruba).

The entire ecoregion can be divided into insular and continental components. A large proportion of marine species are distributed along both the coasts of the greater Antilles and the coasts of Central and South America. Thus, there are biogeographic reasons to group this large area as one ecoregion. However, there are differences in coastal processes, abundance, and distribution of natural communities from islands to continent and from east to west. The coastlines of the ecoregion are diverse, including large river deltas and estuaries, mangrove forests, complex bays and coastal lagoons, offshore cays, upwelling areas, rocky shorelines, and offshore blue holes. There are also a series of coral atolls along the western extent of the ecoregion.

This ecoregion is unique in its coastal morphology. It harbors large land masses with adjacent mountains on both the continent and the larger islands (e.g. Cuba and Hispaniola). There are numerous rivers, both large and small, that naturally transport silt and sediment to deltas, shore, and beaches. Rivers can be both permanent and seasonal. Endemic species have been described for locations in the ecoregion. For example, in the Cayman Islands, three species of mollusks and a species of fish known as the blenny (*Starksia yuineata*) are endemic. The species inventories and descriptions of many taxa are considered incomplete, and there are likely other species restricted to this ecoregion as well. There are regionally critical populations of seabirds and marine mammals (e.g. West Indian manatee), but unfortunately there are no ecological borders incorporated in the management of marine resources.

This large ecoregion—more than 2 million km_—has large coastal population densities, a long history of human use of marine resources, and significant land-based sources of pollution associated with oil extraction, port development, and agriculture. The ecoregion has experienced loss of coastal habitats in the removal of mangroves and diversion of rivers for agriculture. There has been a loss of species, including the Caribbean monk seal and a Jamaican petrel. Spawning aggregations of grouper and snapper species have disappeared throughout the ecoregion. Many countries report the collapse and closure of at least one fishery over the past 20 years.

1.3 Threats to marine biodiversity and the WHS

There are well described threats that apply to coastal systems throughout the tropical area of the region (Table 2). Tropical shallow-water systems are particularly susceptible to changes in coastal hydrology and water quality. Nearshore marine communities are impacted by large-scale changes in coastal landforms, resulting in both acute and chronic sedimentation of coral reefs and hard-bottom communities. The practice of dredging shallow water areas for the development of ports and harbors results not only in sedimentation but loss of habitat for many species. Much concern has been raised throughout the world over the input of inorganic nutrients to a tropical oligotrophic system. The process known as “eutrophication” results in changes in near shore productivity and alters ecological balances responsible for maintaining coral reefs. Changes in coastal water quality, due primarily to organic nutrients but also to contaminants such as polycyclic aromatic hydrocarbons (PAHs) has raised regional concerns about the continued degradation of nearshore marine communities from land-based sources of pollution.

Diseases that are a natural part of the organisms’ biology are perceived as becoming more frequent and more severe with natural climatic cycles such as El Nino/Southern Oscillation Events (ENSO). ENSO events tend to result in elevated surface temperatures throughout the tropical realms, and there is anecdotal information on the occurrence of coral breaching, white band and black band disease in stony corals as well as cellular proliferative disorders (neoplasm or hyperplasm). Water quality changes result from rapid changes in coastal land use with loss of mangroves and loss of seagrass beds. In some countries, coastal population density (numbers of people per kilometer of coastline, inland 20km) is very high , particularly in the small island-states.

In a number of countries that share the marine resources, there are conflicts over harvesting and fishing rights of coastal shelf and bank areas. The Tropical Northwestern Atlantic province, for example, has been described as a large marine ecosystem in crisis in terms of declines of catch per unit effort and shift in catch from large reef fishes (snappers and groupers) to smaller herbivorous fishes (parrotfish) and other less valuable species (grunts, porgies, wrasses, etc.). The coastal resources are managed differently throughout the region, however, collapse of fisheries and decline in their economic importance is most acute in the Caribbean from Hispaniola and Jamaica through the Lesser Antilles. There are a series of problems associated with managing stocks of fishes that occur in a number of national Economic Exclusive Zones (EEZs). In addition to jurisdictional disputes, many fishing methods are destructive to the resource and are thought to be non-sustainable at present levels

of effort. This includes the use of bleach, the collection of live rock, coral, fish and invertebrates for the aquarium trade, the use of hookahs fish and lobster traps, fish seines, fishing spawning aggregations or during the spawning season of a species, as well as shrimping (with huge amounts of bycatch).

Table 1. Sources of threats and their associated stresses to different habitat types in the tropical coastal areas (after Sullivan Sealey and Bustamante, 1999).

Habitat type	Sources of threat	Stress
Seagrass	**1. overfishing (with no quota, closed seasons, size limits, fishing gear restrictions or no-take zones) and illegal hunting** **2. sewage, agricultural run-off** **3. mangrove deforestation** **4. irresponsible boating**	**1. decline of populations of fish, invertebrates, sea turtles, manatees, and alteration of biological communities and habitats** **2. nutrification** **3. near-shore sedimentation** **4. mechanical damage to seafloor, and habitat degradation**
Mangrove (island and continental)	**1. hydrologic alteration for irrigation, urban development, flood control** **2. logging** **3. development of coastal wetlands (dredge and fill activities); coastal aquaculture**	**1. water quality changes (freshwater diversion)** **2. loss of mangrove habitats** **3. loss of coastal fish habitat; coastal erosion**
Coral reef (atolls, banks, fringing reefs)	**1. overfishing (with no quota, closed seasons, size limits, fishing gear restrictions or no-take zones)** **2. sewage, shoreline development** **3. upland deforestation, agricultural run-off** **4. irresponsible diving and boating, destructive fishing practices**	**1. decline of reef fish and invertebrate populations, and alteration of biological communities and habitats** **2. nutrification; increase of algal coverage and coral deterioration** **3. sedimentation; coral deterioration** **4. mechanical damage to coral reefs**

Mixed (large areas with offshore islands, mangroves, coral reefs and seagrass beds)	**1. overfishing (with no closed seasons, size or quota limits, fishing gear restrictions or no-take zones)** **2. sewage, shoreline development** **3. disposal of non-treated industrial effluents and sewage,** **4. upland deforestation, agricultural run-off** **5. development of coastal wetlands (dredge and fill activities)** **6. irresponsible diving and boating**	**1. decline of populations, and alteration of biological communities and habitats** **2. nutrification** **3. sedimentation** **4. pollution** **5. deforestation of mangrove keys** **6. mechanical damage to seafloor (seagrass beds, coral reefs)**
Upwelling	**1. overfishing (with no closed seasons, size or quota limits, fishing gear restrictions or no-take zones)**	**1. population decline pelagic fish**
Beach	**2. unregulated or irresponsible construction**	**2. beach erosion; habitat degradation for sea turtles nesting**
Rocky platform	**3. littering, shoreline development**	**3. habitat degradation**

The strategies for marine conservation must aimed at keeping the coastal environments intact and functioning:

- Preserve the linkages between rivers, streams and terrestrial run-off to the marine environment. Connect land-based conservation projects to coastal marine projects when possible to preserve the natural hydrological cycles, water quality of run-off, and river discharge. Natural links between land and sea, such as coastal wetlands, together with the variability of storms, climate and biological cycles play a critical role in coastal ecology and productivity.
- Select and design "cornerstone sites" that are key in terms of productivity, processes or natural community composition. The selection of key sites within the regions can protect replenishment stocks of fishes and invertebrates, provide a benchmark against which to measure other coastal management practices, and serve as a refuge for species. These cornerstone sites can be parks, protected areas, sanctuaries or just areas with stipulated usage patterns that can serve as models for management practices.

- Promote grass-roots programs in coastal communities to assume a stewardship role to protect and use marine resources in a sustainable way. Develop the methods needed to transfer information to local communities on the "best practices" for coastal development, sustainable harvesting and preserving the quality of life associated with living at the ocean's edge.
- Promote government attention and action to enhance environmental regulations, and foster the creation of different types of conservation areas –marine, coastal and terrestrial- such as parks, biological reserves, **world heritage sites**, as well as networks of protected areas or national park systems.
- We now know that the linkages, selection of sites and stewardship actions depend on sound scientific information to outline the management options. Long term monitoring can then report on the success of management and protection action. The partnership of scientists, conservationists and managers means building and supporting a wide circle of collaborators with strong communications. The emphasis should be on large-scale planning efforts at the ecoregion or coastal systems level, implementing the "best practices" at key sites, and teaching other organizations to duplicate these efforts.

Ideally, an effective regional system of WHS would have to meet the following criteria:

1. Ecoregional representation- All ecoregions must have a certain number of WHS to ensure the protection of core areas of significant value.
2. Connectivity - Considering the importance of ocean currents in the dispersal of propagules, WHS, as MPAs of exceptional value should ideally be located up- mid- and downstream ocean currents, to maximize the protection of sources and sinks of larvae.
3. Habitat representation- Each WHS (or a cluster of 2 or 3 nearby WHS) to include all types of habitats and with such environmental quality so as to allow organisms and populations to perform their basic biological processes (growth, feeding, reproduction, recruitment), and the biological communities to establish fundamental ecological links across habitats. Ideally each “coastal system” (as defined in Sullivan Sealey and Bustamante, 1999), should have a number of PA (and WHS) as a way to contribute to its conservation.
4. Terrestrial – marine linkages- WHS should ideally include terrestrial habitats recognizing the importance of watershed quality in the conservation of coastal areas.
5. Region-specific criteria of conservation status – Considering the long history of human intervention in some areas, biodiversity value of a site depends to the degree of human. The WHS criteria should take into consideration this local specificities and not be universally established, but adapted/associated to the particular scenario of the region. That is the case, for example of the Pacific Islands better conserved than the Insular Caribbean.
6. Small island nations, special cases- Considering the stronger relationship between the terrestrial and marine environments, the significant role of the coastal environmental health in the economic prosperity of small island- nations, as well as their environmental fragility, special consideration and criteria for nomination must be taken with small islands.
7. Transboundary opportunities: A number of conservation initiatives conducted by several organizations (e.g. IUCN, NOAA, Conservation International, The Nature Conservancy, WWF, etc.) have emphasized the ecosystem approach to marine conservation. This advanced

scheme of planning and implementing biodiversity protection is still in its beginning and must be strengthened by the WHS program in order to promote transborder conservation initiatives. This approach has political constraints and hurdles, e.g. the harmonization of policy and legislation to assure the protection of shared resources. There are already a few (and certainly limited) but encouraging initiatives such as the MesoAmerican Reef Initiative, the Belize-Guatemala-Honduras Trinational agreement, the marine peace parks, the sister-parks movement, and others that can be applied to other regions to promote this approach.

8. Linkages between the MPA systems and the WHS program - The WHS program should strive to make the nomination of marine World Heritage Sites not only a high priority all over the world, by cultivating the governments in order to drive their attention to the creation of new protected areas. WHS of marine, coastal and small island biodiversity value must be an object of pride and socio-cultural achievement for local communities and nations. The nomination of a WHS should be seen as the next important step in the lifetime and achievement record of the MPAs as they attain certain levels of effective protection.
9. National and international focus - The WHS program (nomination and overseeing) should contribute to foster a greater attention and political will from local governments and international organizations. There is a great potential for the program to stimulate the creation of new MPAs and promote its usefulness in marine biodiversity conservation.

2. Potential areas to be considered for WHS and opportunities for cluster and transborder nominations

The information provided hereafter was based on the data contained in the discussion paper "Global Review on Tropical Marine, Coastal and Small Island Ecosystems and the WHS" prepared by UNEP-WCMC (Green, unpublished), the information provided by local experts on marine conservation science and MPA management in the region (Annex 1), the authors' review of published and non-published sources of information (including web sites) as well as her own experience as a marine conservation scientist in the Latin American and Caribbean region. The list of proposed sites is not intended to be comprehensive, but a result of the preliminary examination of the existing protected areas in the region, the biogeograhpic and ecoregional context, the conservation issues in the area and the potential areas for nomination as WHS. . In addition to the proposed sites, the authors recognizes the existence of a few other opportunities that have not been included in this analysis due to lack of information (e.g. St Lucia, U.S.V.I., Guyana). The author of this paper encourages the reviewers to provide information to fill this gap, and welcomes any contribution based on new data or a different approach.

Proposed areas with potential for nomination as WHS sites with marine, coastal and small island biodiversity values:

1

PROPOSED NAME OF THE SITE: Cocos Island Biosphere Reserve
COUNTRY(S): Costa Rica
TYPE OF SITE: expansion of existing WHS; with marine, coastal, terrestrial, small island components (manager questionnaire attached)
GEOGRAPHIC POSITION RELATIVE TO: · Marine Province and Ecoregion: Tropical Eastern Pacific; includes an entire marine ecoregion (Cocos Island) · Ocean currents: likely to be mostly self-recruited
DESCRIPTION: The park manager recommended to extend the limits of the park from 2 miles off the coast (territorial sea) to 8.3 miles, in

order to include the pelagic fish and whale populations and to improve the protection of the marine component of the park (15km^2). The terrestrial area includes the whole island (24 km^2).

GEOLOGICAL AND BIODIVERSITY VALUES:

- There are 30 coral species, 260 fish species (27 are found on the island, 20 endemic)
- High percentage of endemic species, both terrestrial and marine: 90 birds (endemic) 260 fishes (23 endemic) 235 plant species (70 endemic)
- Species known to use the island as resting site:
- *Gygis alba* (use the island to mate and raise pigeons)
- *Fregata minor* (nesting colony);
- *Andea herodias* (migratory);
- *Egretta sp.* (3 migratory and resident species);
- *Anas disans* (migratory duck) and other 60 species of migratory birds;
- *Zalophus californianus* (sea lions, resident and migratory)

Nesting ground for birds, resting sites for migratory birds (from the American continent, and the Galapagos Is.). Due to the isolation of the islands, the marine populations might be self-recruited to a great extent.

CONSERVATION STATUS:

Medium to high conservation status due to remoteness, and lack of human presence, However, there are some threats to marine biodiversity and populations: fishing pressure on sharks, groupers, lobster, dolphin, etc., illegal long-line fishing; coral reef death due to elevated temperatures (ENSO-related), some siltation during intense ENSO-related heavy rains, irresponsible diving, unmarked park boundaries, lack of patrol boats and insufficient park rangers, no trust fund.

MANAGEMENT STATUS AND ISSUES:

Management plan exists and was updated in January 1995 for the next 5 years. Next update to be made in July 2001.

Management needs:

- Improve the vigilance and control of illegal fishing activities.
- Improve the scientific knowledge (via research), e.g. marine inventories, climate and oceanographic research
- Provide autonomous operations in the area by having a vessel with own crew for patrolling and investigation
- Create a heritage foundation
- Lack of financial resources for all the above

EXISTENCE OF ENVIRONMENTAL MONITORING:

Non-systematic coral reef monitoring (University of Costa Rica, Centro de Investigaciones Marinas) due to remoteness (360 miles from mainland) and lack of boat

CONSTRAINTS FOR NOMINATION: unknown

.

PROPOSED NAME OF THE SITE: Belize Barrier Reef System (map of the MMMT, and Gladden Spit marine reserve)

COUNTRIES: Belize, Mexico

TYPE OF SITE: expansion of existing site; cluster; with terrestrial, coastal, marine, and small island components; transborder

DESCRIPTION:

The existing Natural World Heritage Site, meets the criteria ii, iii, iv, and is composed of a serial nomination of the following sites:

- Laughing Bird Caye National Park, II (National Park),
- Half Moon Cay Natural Monument, III (Natural Monument),
- Blue Hole Natural Monument, III (Natural Monument),
- Glovers Reef Marine Reserve, IV (Habitat/Species Management Area),
- South Water Cay Marine Reserve, IV (Habitat/Species Management Area),
- Sapodilla Cayes Marine Reserve, IV (Habitat/Species Management Area) 4 on the 260km reef (largest in the northern hemisphere), the northernmost lying just south of the international border with Mexico and southernmost on the tip of the reef in the Gulf of Honduras (near Guatemala).

However, due to the recent establishment of several protected areas in southern Belize and the interconnectivity of these areas with the barrier reef and its contribution to the area's ecological integrity, an expansion of the WHS is proposed to include the following protected areas:

- National Park Arrecifes Xcalak in Mexico (terr: 4 543 000, marine: 13 495ha),
- Maya Mountains- Marine Transect (MMMT), and
- Gladden Spit Marine Reserve (in Belize).

The MMMT is located in the southern half of Belize and a terrestrial area that covers tha Maya Mountains, the Deep river basin, great part of the Monkey River basin, the Ycacos lagoon and the Port of Honduras. The Gladden Spit Marine Reserve is located ca. 30 NM off Placencia city, where the barrier reef curves from a NW-NW direction to a NE-SW direction, thus projecting towards the northern margin of the Cayman Trench.

GEOGRAPHIC POSITION RELATIVE TO:

- Marine Province and Ecoregion: Marine Province and Ecoregion: Tropical Northwestern Atlantic province, Central Caribbean marine ecoregion
- Ocean currents: midstream within the ecoregion; with documented local oceanic gyre circulation along the eastern side of the shelf break

GEOLOGICAL AND BIODIVERSITY VALUES:

The biological and geological value of the Belize Barrier Reef System is thoroughly described in the WHS nomination documents.
The MMMT includes a 415km^2 polygon of coastal waters and straddles a gradient from fresh-water dominated estuaries inshore to marine-dominated waters and coral reefs to the east. This embayment contains more than 130-mangrove lined cays and important fish nursery areas.
Several bird species of concern for conservation are found in the cayes and atolls. Three species of sea turtles nest in Belize and are routinely encountered between the coast and the barrier reef, and on the atolls: loggerhead, green, and hawksbill. Turtles nest at a few mainland sites and on offshore cayes and atolls. The American crocodile is found among the offshore cays and atolls, and nesting is known to occur at several sites

CONSERVATION STATUS: Coastal development and tourism (effluents and sediments from urban and agriculture areas threaten the marine environment), overharvesting of marine resources, including fish, marine turtles and manatee hunting

MANAGEMENT STATUS AND ISSUES:

EXISTENCE OF ENVIRONMENTAL MONITORING:

CONSTRAINTS FOR NOMINATION: none expected

PROPOSED NAME OF THE SITE: Yucatan Reefs (map of the in ANPs-QROO.gif)

COUNTRIES: Mexico and Belize

TYPE OF SITE: cluster; expansion or new site; terrestrial, coastal, marine and small islandcomponents; transborder.

GEOGRAPHIC POSITION RELATIVE TO:

- Marine Province and Ecoregion: Tropical Northwestern Atlantic province, Central Caribbean marine ecoregion
- Ocean currents: midstream of the ecoregion, upstream of South Florida and western Cuba; likely local larvae retention by meandering circulation along the shelf edge of the ocean current flowing northward

DESCRIPTION:

Option 1. Expansion of the existing WHS Sian Ka'an Biosphere Reserve at the state of Quintana Roo, along the Caribbean coast of Mexico (currently with 528,000 ha that was the extent of the original reserve established in 1986) with the area that was added to the reserve to protect adjacent ecosystems. This additional area covers 89 000 ha of wetlands (added in November 1994 to the Biosphere Reserve) to protect the upper basin of Espíritu Santo Bay, and 35 000 ha of marine area added in February 1998 to protect the adjacent coral reefs. They are part of the Yucatan Bay's priority coastal system of the Central Caribbean marine ecoregion (Sullivan Sealey and Bustamante, 1999).

Option 2: The expansion of the existing WHS Sian Ka'an Biosphere Reserve by including the adjacent area stated above plus a series of coral reef marine protected areas recently established such as (from north to south)

- National Park Arrecifes Alacranes (off the northern coast of the Yucatán Peninsula)
- National Park Isla Contoy (terr area: 226ha, 4901ha);
- National Park Costa Occidental de Isla Mujeres, Punta Cancún, Punta Nizuc (a cluster park) (marine area: 8673ha);
- Sian Ka'an Biosphere Reserve (terr: 372 787ha, marine 155 369ha
- Arrecifes de Sian Ka'an (terr: 1 362ha, marine: 33 565ha)
- National Park Arrecifes de Puerto Morelos (marine 10 829ha);
- National Park Arrecifes de Cozumel (marine: 11987ha) ;
- Reserva de la Biosfera Banco Chinchorro (terr: 490 824 ha, marine: 143 361 ha) located 28.5km to the SW of Sian Ka'an,
- Santuario de la Tortuga Marina Xcacel-Xcacelito (terr: 35ha, marine: 327ha)

- National Park and Marine Reserve Bacalar Chico

A great part of the proposed site is contained in two priority coastal systems of the Central Caribbean marine ecoregion: Yucatan Bays and Banco Chinchorro.

Option 3. Create a separate, new WHS with the MPAs listed above and name it Arrecifes de Yucatán (Yucatan Reefs)

Option 4: Merge the Sian Ka'an Reserve, the Yucatan Reefs MPAs, with the Belize Reef System WHS to create a MesoAmerican Reef WHS

GEOLOGICAL AND BIODIVERSITY VALUES[1] :

The State of Quintana Roo is located in the eastern part of the Yucatan Peninsula (mostly less than 2km wide), in the Caribbean Sea. It comprises a linear coastal span of approximately 375 km. The shelf is narrow in comparison with the northern portion of the Peninsula. The entire Quintana Roo state is a karstic system. Rainwater infiltrates the porous carbonate rock so there are no surface streams in the peninsula. Instead, there are numerous sinkholes ("cenotes") and undergrounds rivers. Freshwater is discharged in the coastal area through springs, except in Sian Ka'an. A coastal current flows northward off the coast resulting from westward traveling anticyclonic gyres. There is a seasonal upwelling system off Cabo Catoche (northeastern corner of the Peninsula), which could have some influence down to Puerto Morelos. The upwelling has a seasonal cycle, rising from the deep layers of the sea entering the photic zone but not reaching the ocean surface, hence it has a fertilizing effect on water masses.

The major coastal geomorphological features identified are, from north to south 1) A wide platform starting in Punta Maroma and extending northeast 2) Cozumel Island 3) The large bays of Ascension and Espíritu Santo 4) the Xcalak Trench and 5) Chinchorro Bank. There is an almost continuous reef bordering the whole coast (recognized as a fringing reef by Darwin in 1842).

The Quintana Roo shelf can be divided into two major areas, using Punta Maroma as a reference point. Southward, the shelf is a narrow platform with a sharp slope. Northward, the platform starts widening. This contrast and the differences in the shelf morphology explain differences in reef development. The reef profile is interrupted by well developed wave-cut terraces at about 910 m. Fore edges described in this paper mostly develop in the first terrace where environmental conditions are severe, although it is more plausible to associate fore edge buttress-like reefs with origins of erosion rather than accretion.

Upon reaching the Yucatan Peninsula, the presence of Cozumel Island modifies the Caribbean Current to form the Yucatan Current.

South of Cozumel part of the current is funneled into the channel thereby accelerating its speed up to 4 knots. The current's speed is assumed to influence sedimentation rates and possibly coral larvae settlements, particularly in Playa del Carmen. Ocean circulations studies have shown the presence of small eddies between rocky points where objects are trapped for a period of time moving northward and then southward and so on, until the drifter finally reaches the coast. For coral larvae caught in these eddies this might imply traveling distances of a few meters or many kilometers in a microscale process.
Ascension and Espíritu Santo are twin bays, which resulted from extensive normal faulting during the Tertiary. Quintana Roo belongs to two physiographic regions; The Northern Pitted Karst Plain fringed by barrier beaches and dunes, developing from Cancun to Tulum; and the Eastern Block-Fault District that extends from Tulum to Belize. The bays along with Chunyaxche Lagoon represent the northward extension of the Eastern Block-Fault. The geological characteristics and hydrological dynamics outside the bays differ from the rest of the coast.

The fractures present in the Yucatan karstic platform act as conduits for the mixing of fresh groundwater and marine water. This results in an undersaturated calcite solution that causes maximum dissolution of limestone. Thus, maximum fracture density of the Eastern Block-Fault District, is closely related to a high incidence of coves, with exceptional beauty.
There seem to be differences in reef development along the coast associated with bottom relief and the steepness of the reef slope. Recent studies have proven the existence of highly developed and extensive spur and grove systems in the central and southern coast. Cozumel Island and Banco Chinchorro (an atoll-like structure) present developed leeward reefs and highly developed windward reefs. The Alacranes Reef is located in the Campeche Bank, 130km off Progreso city, in the northern coast of the Peninsula. It is an atoll formation composed of 5 islands. The Campeche Bank, is an underwater extension of the Yucatan Peninsula, which slopes gradually northwards for about 200 km and descends abruptly into the Sigsby Deep. The Gulf of Mexico is basically an area of terrigenous sedimentation, but scattered reef growth is found with relict coral and algal mounds over much of the shelf. The Alacranes Reef atoll is the northernmost reef in the Bank of Campeche. It comprises five islands: Pérez, Chica and Pájaros, located in the southern region; Desertora runs SW and Desterrada runs NW. Physiographically, Alacranes Reef has a windward reef on its east side, a not well developed discontinuous leeward reef on the southwestern side, and a lagoon divided into three areas: one about 8 m deep near the west margin, another east of Isla Pérez (the deepest part), and the remaining one, where ridges of coral present a cellular pattern. The outer slope of the reef is heterogeneous, with the presence of a spur and groove zone along the east ridge below a depth of 10 m. The slope is abrupt from the upper ridge to 3035 m depth where it forms a terrace and leads into the sandy sediment of the Campeche Bank. Amongst the main biotopes found here are easily identifiable coral patches in the open west lagoon, as well as on the slopes of the cells at the eastern lagoon, and in sandy flat areas and *Thalassia* beds.

The main characteristics of the Mexican Caribbean reef system are, namely:

• The incline of the reef slope creates a more severe shallow environment north of Punta Maroma, limiting reef development and promoting higher sedimentation rates.

• Southern fore reefs up to Puerto Aventuras develop where the most stable conditions prevail, allowing accretion over long periods of time.

• The spur and groove systems seem to have formed from strong accretion processes and do not originate from erosion processes; in particular below 20m.

• Cozumel Island influences current conditions, hence its presence determines the lack of structural spurs north of Puerto Aventuras.

• Most of the Quintana Roo Fore Edge lies on the 810 m terrace, colonized by a coral community, but environmental severity in the shallows might not allow for very substantial reef accretion.

• Chinchorro's shadow allows high coral reef development adjacent to the mainland, from Xcalak to Bacalar Chico, allowing the development of the Xcalak Trench.

[1]. The information was taken from “Implementation of the International Coral Reef Initiative in Mexico ”, by Bezaury et al. (1997)

Option 1. This new WHS which would encompass the Sian Ka'an B. R. and the Arrecifes de Sian Ka’an B. R. will add 133 000 ha to the existing 528 000 Sian Ka’an WHS ecosystems such as the mangrove wetlands (89,000 ha), and 35 000 ha of the adjacent seagrass-coral reef complexes.

Option 2.

The inclusion of all the 6 marine parks and reserves along the Caribbean coast of Mexico would add to the area the following values:

- Chinchorro Bank is an atoll coral reef complex located 30 km off Quintana Roo's south coast). It is built over a deep submarine crest rather than a continental or insular platform, as it is considered an atoll and at the same time the only reef to have existed before the Pleistocene within Mexican waters. It has greater biodiversity and is more heterogeneous than the platforms of the Campeche Bank. It has an area of 800 km^2 composed mainly of a sandy bank. It is 46 km in length and 15 km in width. The general morphology of the reef structures on the windward margin of the atoll are greatly influenced by the depth of the subadjacent substrate and the presence of an extensive and gently dipping platform; this platform is not found on other western

Caribbean atolls ; the bank has outstanding geomorphic features, and exceptional beauty (criteria i, ii). It has also high *in situ* conservation value due to its geological, and ecological features, as well as remoteness (lack of tourist visitation) and the existence of abundant populations and breeding sites of threatened species (such as queen conch, groupers and snappers, severely depleted in other areas of the Mexican Caribbean coast).

- the Puerto Morelos Reef (with exceptional value as described by recent studies), which has and has been substantially studied;
- the small island and reefs of Isla Contoy, due to its location close to the seasonal upwelling system off Cabo Catoche, is an important breeding and resting area for various seabirds that feed upon the abundant fish sustained by the elevated productivity
- the most important reef areas of the Yucatan Peninsula (i.e. the above mentioned reef areas as well as the rest of the marine parks and reserves of the Mexican Caribbean);
- the Alacranes Reefs, in the Campeche Bank, off the northern coast of the peninsula, provides a larger area for breeding, recruitment and residence of upstream sources of larvae and juveniles.

The new site will be a cluster or protected areas that comprise important terrestrial and marine (coastal and offshore) ecosystems of the Yucatan Peninsula, all interconnected via the predominantly northward-moving ocean current as it flows off the northern portion of the Belize Barrier Reef to the Yucatan Channel.

Option 3. This is the least recommended of the three options as it will lack the inclusion of important terrestrial ecosystems such as the Sian Ka'an coastal wetlands and adjacent terrestrial ecosystems, which provide habitat and land-based sources of nutrients to the adjacent marine ecosystems.

Option 4. The creation of a cluster, transborder, with terrestrial, coastal and marine components WHS (MesoAmerican Reef) may contribute significantly to the protection of the whole system.

CONSERVATION STATUS:

Caribbean coral reefs hold the most developed reef structures in México and apparently some of the most pristine reef areas remaining. Nevertheless, since the 1960s, the reefs have been subjected to intense artisanal fishing effort, whose impact has not been evaluated. Tourism has become an increasing reef impacting activity since the mid 1970s. Small reef patches such as El Garrafon at Isla Mujeres and Punta Nizuc at Cancun, have been completely destroyed by tourism and impacts are becoming more evident along the Cancun-Tulum Touristic Corridor in places such as Akumal and Puerto Morelos. This tendency seems to be accelerating and impacts derived not only from direct touristic use, but from impacts caused indirectly by tourism, such as urban growth and coastal development without adequate sewage treatment on karst subsoil, are becoming the important threats.

The following table summarizes the natural and human impacts over the proposed site (Bezaury et al., 1997):

Natural impacts:

Hurricanes: All reefs, frequency high, variable magnitude and relatively fast recovery (Fenner, 1991; Rodriguez-Martinez, 1993; Crespo-Romero, 1991; García *et al*., 1996).

Bleaching: All reefs, eventually, moderate and localized effects (García et al, 1996). Black band disease: All reefs, sporadic effects on isolated colonies effects (García et al, 1996).

Anthropogenic

Overfishing:

Black coral: Cozumel island and North Coast. Highly damaged populations (Kenyon, 1993; Camarena, 1996; De la Torre, 1978).

Monk seal: Exterminated in Caribbean Sea in the middle of the century (Villa *et al*., cited in Morales, 1987)

Sea turtles: Endangered (Durán, 1990; Durán, 1991; Gil, 1988; Gil y Miranda, 1990).

Groupers: R\reduction in numbers due to overfshing of spawning aggregations in south of Q. Roo (Aguilar *et al*. 1994).

Conch: Overfishing in the entire state (Cruz-Santabalbina, 1986).

Lobster: Fisheries decline (Orr, 1985).

Souvenirs: Harvesting of corals, gorgonians, sea stars and shells mainly (Jordán, 1993).

Aquarium: Low scale. Mainly fishes, corals, anemones, algae and live rock for local people and aquarium trade. Potentially dangerous effects (Jordán, 1993).

Tourism: Intensive diving (international destination).

Nautical sports: There are ca. 700 boats in Cancun (National Park Costa Occidental de Isla Mujeres, Punta Cancun y Punta Nizuc)

Tourism infrastructure: All along the coast. High density and short term during construction; low intensity and long term impacts

during operation (Jordán, 1993).
Urban pollution: Mainly in Cancun-Tulum corridor. Percolation of pesticides and agricultural chemicals and sewage to underground water (Jordan, 1993).
Anchor and propeller damage: All Quintana Roo. Caused by fishermen and boats.
Shipwrecks: Several old vessels on Banco Chinchorro (Aguilar *et al.*, 1993).

MANAGEMENT STATUS AND ISSUES: All these parks and reserves have management plans and are the focus of attention from the government, business sector (fisheries and tourism industries, developers), NGOs and academic institutions in Mexico. However, there are still problems related to lack of financial resources, insufficient monitoring data for adaptive management , etc.

EXISTENCE OF ENVIRONMENTAL MONITORING: Several academic institutions such as Ecosur, Universidad Nacional Autonoma de Mexico, Universidad Autonoma de Yucatan, CINVESTAV-Merida, etc., as well as local (Amigos de Sian Ka'an, etc.) and international academic and conservation organizations (The Nature Conservancy, WWF, University of Rhode Island, etc.) and funding agencies (GEF, World Bank, etc.) and regional research programs (ReefCheck, AGRRA, CARICOMP) have conducted and supported environmental research and monitoring programs in the region.

CONSTRAINTS FOR NOMINATION:
Includes two neighboring countries

PROPOSED NAME OF THE SITE: Fernando de Noronha and Atol das Rocas

COUNTRY(S): Brazil

TYPE OF SITE: marine component; recently nominated after postponement in 2000

GEOGRAPHIC POSITION RELATIVE TO:

- Marine Province and Ecoregion: Tropical Southwestern Atlantic Northeastern Brazil
- Ocean currents: upstream of the Guiana Current flowing northward

DESCRIPTION:

Fernando de Noronha Marine National Park (18 islands) and the Biological Reserve of Atol das Rocas (2 islands), with a 140,713 ha proposed buffer zone following the contour of the 2,000m isobath. Both Archipelagos have similar flora and fauna and lie on the same continental platform.

The Archipelagos Fernando de Noronha and Atol das Rocas are situated off the Calcanhar Cape. The latter lies about 200 km northeast of the coast of Rio Grande do Norte State. It is an almost circular atoll reef. The former is a volcanic archipelago of one principal 17-km_ island and 18 islets, lying 350 km northeast of Cape São Roque. Both archipelagos have similar flora and fauna and lie on the same shelf.

GEOLOGICAL AND BIODIVERSITY VALUES:

The area includes the following critical habitats and species populations:

- unique type of coral reef (atolls) that are unfragmented

and have little algal coverage.

- documented bird and turtle nesting sites.
- breeding and nursery areas for marine mammals (Fernando de Noronha Archipelago is an important habitat for dolphins)
- major bird rookery areas (Atoll das Rocas is known for its abundant seabird nesting colonies).

The area meets criteria i, ii iii, and iv. The area has important breeding and feeding grounds for invertebrates, fish, sea turtles, sea birds, and marine mammals

Because of its isolation and location downstream of the Warm Equatorial Current, the area might have local gyres that provide

oceanographic conditions for retaining propagules of local populations. This condition enhances the need to protect the breeding and nursery areas to maintain the integrity and sustainability of the local marine system and species populations
There is no information about circulation patterns, however, the site might also serve to an unknown extent as a source of larvae to downstream areas along the coast of northern Brazil and the Guiana Marine Ecoregion.

CONSERVATION STATUS:
The area is highly conserved however there are some potential threats to the biodiversity health, namely:
Intensive fishing, tourism (less intensive), pollution by urban wastes (the main island is the only inhabited, but it is very small). There is no significant construction in the island,

MANAGEMENT STATUS AND ISSUES:
The government manages the park, but enforcement of regulations is weak due to a lack of qualified personnel and financial resources, but also of government attention. Although environmental and resource use regulation is strong and in place, enforcement is not effective.

EXISTENCE OF ENVIRONMENTAL MONITORING:
Few research or monitoring projects

CONSTRAINTS FOR NOMINATION: unknown
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PROPOSED NAME OF THE SITE: Reentrancias e lencois Maranhensis

COUNTRIES: Brazil

TYPE OF SITE: new, coastal

GEOGRAPHIC POSITION RELATIVE TO:

- Marine Province and Ecoregion: Tropical Southwestern Antlantic province; Amazonian province
- Ocean currents: mostly influenced by terrestrial runoff rather than the oceanic currents as the site is mostly comprised of mangrove/coastal lagoon type of ecosystems.

DESCRIPTION:

Located in the Amazonian marine ecoregion, northeastern coast of Brazil (State of Para and Maranhao). Reentrancias e lencois Maranhensis Environmental Protection Area is a RAMSAR site with an area of 2 680 911 ha. The site includes an extensive and highly conserved representation of mangrove, dunes, estuaries, mud flats and coastal lagoons ecosystems and nearshore marine habitats.

GEOLOGICAL AND BIODIVERSITY VALUES:

The area is one of great beauty and remarkable features. There are representatives of both littoral and pre-Amazonian regions. Vast mangroves support an abundance of fish, invertebrates and birds, and abundant fisheries resources. The area acts as an important protective barrier for the human settlements living along the coast and river margins. The area supports a great amount of biodiversity including the bird *Eudocimus fluvaitilis* as well as some mammals such as *Sotalia fluviatilis* the manatee *Trichechus manatus* and marine turtles. It is a key shore bird habitat. Surveys have demonstrated the global importance of this area. Mangrove forests account for 60% of the total mangrove area of the state of Maranahao. The numerous bays (more than 14) are characteristic of this type of estuarine area. Sandy beaches, coastal dunes, low-lying islands and rivers are common.

The biodiversity values include the presence of fish nursery and spawning grounds, outstanding mangrove forests, and bird and sea turtle nesting sites.

The area has important archeological sites.

CONSERVATION STATUS: The area is in very high conservation status, nearly pristine due mostly to its remoteness and low population density. However, there are some threats to marine biodiversity such as intensive fishing, including foreign poaching of shrimp and sharks.
MANAGEMENT STATUS AND ISSUES: lack of resources for park regulation enforcement and little attention by the government.
EXISTENCE OF ENVIRONMENTAL MONITORING: limited
CONSTRAINTS FOR NOMINATION: unknown

NAME OF THE SITE: Andros Island (or Andros National Park) (map)

COUNTRIES: The Bahamas

TYPE OF SITE: new site; with terrestrial, coastal, marine, small island components

GEOGRAPHIC POSITION RELATIVE TO:

- Marine Province and Ecoregion: Tropical Nonwestern Atlantic Coastal Biogeographic Province, Bahamian Archipelago Marine Ecoregion
- Ocean currents: Andros Is. Is located along the west side of the Tongue of the Ocean, and might be a source of larvae and recruits for this and other islands to the east and north.

DESCRIPTION: The site comprises the Andros Island and its offshore cays, extending from the adjacent marine environment, ranging from the 100-fathom depth contour lying to the east to a distance of 15 NM north, south and west of the island's shoreline. It includes the terrestrial and marine areas.

GEOLOGICAL AND BIODIVERSITY VALUES:

- Andros Is. is the largest island in the Bahamian Archipelago with vast areas of native coppice, pinelands, very large freshwater lens, scrub, and saltwater marshes, together with extensive saltwater creeks, mangrove areas, seagrass beds, and numerous nearshore and offshore creeks. It has the highest density of blue holes in the world.
- The fringing-barrier reef system lying off the east coast is the second largest reef complex in the Tropical Northwestern and Southwestern Atlantic Provinces and one of the most remote to urban centers. It extends ca. 200 km from Joulters Cays in the north to South Cay in the south. Numerous patch reefs and oceanic blue holes lie within the lagoon.
- Joulters Cays, a chain of islands of ooid sand (ooilite) surrounded by ooid shoals penetrated by tidal channels are one of the foremost field sites of the world
- 34 endangered or threatened species of birds (Birdlife International): West Indian whittling duck (*Dendrocygna arborea*); the piping lover (*Charadrius melodus*); the Kirtland's warbler (*Dendroica kirtlandii*) and the Bahamas swallow (*Tachyneta cyaneoviridis*);
- flocks of greater flamingos (*Phaenicopterus ruber*) are present in the southwestern section of north Andros (the existence of nest has not been determined)

- seabirds actively nesting on offshore cays of Andros: Audubon shearwater (*Puffinus herminieri*), white-tailed tropicbird (*Phaeton lepturus*), bridled tern (*Sterna anaethetus*), sooty tern (*S. fuscata*), brown noddy (*Anous stolidus*)
- presence of the endangered hawksbill turtle (*Eretmochelys imbricata*)
- Cat Island turtle *Trachemys terapen* (endangered in the Bahamas)
- rock iguana (*Cychlura cychlura cychlura*), an endemic species listed as vulnerable;
- abundant populations and spawning aggregations of Nassau grouper (*Epinephelus striatus*) severely depleted in the rest of the Caribbean);
- queen conch (*Strombus gigas*), and helmet shells (*Cassis* spp.) are intensively harvested in Andros but their populations are among the most abundant in the Caribbean extensive formations of staghorn coral *Acropora palmata*
- extensive bonefish (*Albula vulpes*) population throughout the bights, the western nearshore areas and the tidal creeks.
- Two Nassau grouper spawning aggregation sites lie eastward of the reefs crest

Status of the Andros Is. is high due to low usage intensity.

CONSERVATION STATUS:

The conservation status of Andros Island is significantly higher than that of other tropical areas of the Tropical Northwestern Atlantic due low human population and low intensity of resources usage. However, lack of regulations on development, harvesting and environmental protection may compromise the status of species and ecosystems in the near future. The main threats to biodiversity are: commercial overharvesting of queen conch, spiny lobster, land crab and helmet shells, depletion of freshwater lens by water barging to New Providence, mangrove clearing, local sand mining, mechanical damage of reef structure from anchoring, diving, vessel groundings and fishing (e.g. monofilament line accumulation), lack of proper sites for disposal of garbage and toxic wastes, limited and improperly constructed septic systems, presence of US and UK naval weapons testing range (AUTEC), particularly ship and submarine groundings, acoustic testing impacts, especially on marine mammals, toxic chemical leakage (e.g. cyanide-based Otto II torpedo fuel and sonobuoy lithium battery decomposition), benthic accumulation of torpedo (copper) guidance wire, cable laying)

MANAGEMENT STATUS AND ISSUES:

There are no protected areas established in Andros yet. The Bahamas National Trust (BNT) in partnership with the Andros Conservancy and Trust (AANCAT) and more recently with The Nature Conservancy (TNC) has submitted a proposal to the government for the establishment of a national park in Central Andros comprising substantial marine and terrestrial areas. The

delineation of the park has been approved by the Prime Minister's office.
In addition, the Wetlands Restoration Committee under the Bahamas Environment, Science and Technology Commission (BEST) has opened up one creek in the north Andros areas and voiced interest in the inclusion of additional wetlands in the central Andros National Park proposal.
Species harvesting regulations (established mainly by the Depts. of Agriculture and Fisheries), including the closure of fishing in High Cay during the Nassau grouper spawning periods (a major spawning site) are difficult to enforce due to lack of human resources, inconsistencies in enforcement policies and judicial compromise. The Andros bonefishing Association assures local adherence to the regulations regarding bonefishing, oversees the training of bonefish guides flats and adjacent areas and in general, keeps watch over the bonefish and adjacent reef areas.
The emergence of ANCAT with assistance from other organizations such as The Bahamas Reef Environmental Education Foundation (BRREF), The Nature Conservancy (TNC), the Andros Bonefishing Association (ABA), and The Bahamas National Trust (BNT), the Dept. of Fisheries and the Ministry of Tourism may contribute to increase the attention to the needs of conserving Andros Is. terrestrial and marine ecosystems. Environmental legislation is weak and the enforcement of resources regulations, established by the Dept. of Agriculture and Fisheries is difficult and inconsistent due to lack of human resources and judicial compromise.

EXISTENCE OF ENVIRONMENTAL MONITORING:

- Sea surface temperature - Atlantic and Gulf Reef Rapid Assessment (AGRRA) program led by the University of Miami
- Meteorological data (sea state, wind speed and direction, barometric pressure, air and sea temperature, sky cover) by Atlantic Undersea Test and Evaluation Center (AUTEC)
- Nearshore ecological monitoring at AUTEC sites- by U.S. Naval Oceanographic Office (NAVOCEANO)
- Reef fish surveys – Reef Environmental Research Foundation (REEF)

Some research projects have received limited funding from IDB.

CONSTRAINTS FOR NOMINATION:

- National park establishment in process (waiting for approval by the government)
- The Bahamas is not a signatory party of the WHS Convention.

PROPOSED NAME OF THE SITE: Exuma Cays (map)
COUNTRIES: Bahamas
TYPE OF SITE: terrestrial, coastal, marine and small islands components
GEOGRAPHIC POSITION RELATIVE TO: · Marine Province and Ecoregion: Tropical Northwestern Atlantic Province, Bahamian Archipelago Marine Ecoregion · Ocean currents: along the south margin of the Exuma Sound, an important source of larvae
DESCRIPTION: The proposed site includes the Exuma Cays Land and Sea Park (ELSP) and a few small coastal and terrestrial protected areas along the Exuma Cays (list and description of these parks to be included later). The ELSP is located approximately 65 miles SE of the capital city of Nassau, New Providence. It was established in 1958 to preserve the islands and marine resources of the Exumas and encompasses 56 410ha (456 km^2) of this shallow water island ecosystem. As the islands themselves are relatively small, only 1460 ha (2.5%) within the park are land area. The park has the shape of a rectangle whose west side faces the Tongue of the Ocean and the east the Exuma Sound, two important Atlantic oceanic waters entering the carbonate shelf of the Bahamian Archipelago.
GEOLOGICAL AND BIODIVERSITY VALUES: The park includes 10 low-relief limestone islands, small cays, and hundreds of square kilometers of shallow and deep-water tropical marine habitats. The islands contain diverse biological communities primarily composed of dense native broadleaf “bush”, palm forests, dunes and shallow brackish ponds and lagoons that are recharged by rainstorms or daily tidal cycles, respectively. These terrestrial habitats are known to be important habitats for rare and endangered iguana and hutia (banana rat) species and several marine birds that nest in the park. The marine habitats are primarily represented by coral reefs (patch and channel reefs), seagrass beds, shallow sand banks and mangrove fringing mangrove forests along the tidal channels and island margins. The park is one of the only locations in the Caribbean sea known to harbor stromatolites. These large colonies of blue-green algae are true “living fossils” known to exist since the Pre-Cambrian period more than 600 million years ago. The Nassau grouper and snapper fish assemblages of the park are close to its “natural” status due to protection

CONSERVATION STATUS:

High in the marine component of the park (enforcement of the no-take condition has increased in the last years);
There is scientific documentation that the grouper (Epinephelus; Mycteroperca) species composition and abundance is higher than in the surrounding area due to protection.
Terrestrial conservation issues still exist (feral animals).

MANAGEMENT STATUS AND ISSUES:

The park was established in 1975 (it is the second oldest in the Caribbean) and is managed by the Bahamas National Trust (BNT). BNT is a statutory, non-profit and non-governmental organization devoted to the conservation and management of The Bahamas natural and historic resources.
A management plan was drafted in 1996, and more recently the park objectives were stated, including the protection of all marine and terrestrial animal and plant life. Conservation planning efforts are ongoing in between the Bahamas National Trust and The Nature Conservancy, including the elaboration of a site conservation plan based on scientific expertise and stakeholder input.

EXISTENCE OF ENVIRONMENTAL MONITORING:

Various research and monitoring projects in the park and surrounding area by universities, research and conservation institutions, including the description of the water quality, the ecological status of reefs, the grouper species composition, the queen conch abundance, distribution and recruitment; the description of the recreational boating activities, etc.

CONSTRAINTS FOR NOMINATION: The Bahamas is not a signatory country of the WHS convention.

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P**ROPOSED NAME OF THE SITE**: Saba Island and Bank (map from web site)

COUNTRIES: Saba, Netherlands Antilles

TYPE OF SITE: new site**;** with terrestrial**,** coastal, marine, small island and bank components; cluster (island and bank)

GEOGRAPHIC POSITION RELATIVE TO:

- Marine Province and Ecoregion: Tropical Northwestern Atlantic Province, Lesser Antilles Marine Ecoregion
- Ocean currents: No data

DESCRIPTION:

Saba Island has a land area of 12 km^2 and 1000 inhabitants.

The island of Saba is surrounded by a marine protected area, the Saba Marine Park which has the status of a national park. The park boundaries are extensive, ranging from the coastline to the 200ft or 60-meter depth contour and all around the island. The total area of approximately 2000 ha is patrolled on a daily basis by marine park personnel.

The park extends down to the 60m depth contour and incorporates an offshore seamount complex. Although the Saba Marine Park was declared a national park in 1998, the park is designed for multiple-use, supporting a variety of activities, i.e. diving, snorkeling, fishing and sailing. Protection of the fragile coral reefs around Saba is the most important task of the park. Dive tourism is one of the more important economically significant activities on the island generating an estimated $2 million per year.

A terrestrial park is being established along the north coast and runs from the shoreline to 870 m elevation. It encompasses all vegetation types present on the islands from dry scrub to cloud forest. The park is 43 ha (the entire surface area of Saba is 1,250 ha) and is owned and managed by the Saba Conservation Foundation. Despite the relatively small size, national park status is being sought. The park is considered as the nucleus of a larger national park in the future.

The origin of the Saba Marine Park dates back to 1984, when the Island Government requested the advice of the Netherlands Antilles National Parks Foundation (STINAPA) on developing and managing the island's marine resources in an attempt to integrate development of a small diving industry with resource conservation.. The short answer to that was to create an island-wide marine park with zoning applied to accommodate different uses with a minimum amount of conflict. The park was established in 1987 through the Marine Environment Ordinance Saba and is managed by a local NGO, the Saba Conservation Foundation. The development of the Saba Marine Park bears a number of resemblances to that of the Bonaire Marine Park:

- very few human impacts had affected the marine environment

- the local Government understood the importance of resource conservation
- dive operators were conservation-minded and installed a number of moorings at their own initiative
- the proposed park would include all nearshore waters down to the 60 m depth contour
- the park would be legislated through a comprehensive marine environment ordinance.

GEOLOGICAL AND BIODIVERSITY VALUES:

- On hundred and sixty seven reef fish species have been recorded in the park. Reef fishes are abundant, particularly groupers, which are severely depleted in other Caribbean islands.
- Humpback whales migrate through the Lesser Antilles and their spouts or clicks and songs can be heard while diving in the park.
- Sharks, including the Gray reef shark, Black-tip shark, Nurse shark and Hammerhead shark are common around the reef pinnacles. Southern stingrays are common, while Spotted eagle rays and even Mantas are among the occasional sightings.
- Sea turtles are frequent sightings in Saba waters. Both the Hawksbill turtle as well as the Green turtle are commonly encountered.
- The Saba Bank is one of the broadest banks of the Eastern Caribbean
- The bank was classified as an atoll (Van der Land, 1977), but limited research has so far been conducted; systematic habitat classification and mapping, and biodiversity assessments of the bank have yet to be undertaken.
- Living coral reefs are located along the coast of Saba and at the edge of the bank, especially on its eastern and southeastern edges. The reefs along the eastern edge have been described as very rich in terms of cover and diversity of reef-building corals. The coral reefs may well represent an important source of fish and coral larvae for down current locations in the northeastern Caribbean.
- The Saba Bank provides important habitat for spiny lobster (Panulirus argus) and queen conch (*Strombus gigas*) within the Eastern Caribbean otherwise dominated by narrow shelf areas.
- Humpback whales are seen occasionally as they migrate through the area
- Sea turtles are frequently sighted and the bank may be an important feeding ground for them.
- Known spawning aggregations of queen triggerfish and squirrelfish occur in the bank.

CONSERVATION STATUS:

- A baseline study, 'Monitoring Coral Populations of the Saba Marine Park, A Baseline Survey' (Deslarzes and CMcIvor, 1996) shows that although Saba does not have a high coral coverage, the health and pristine conditions of the reefs are important assets
- One of the most desirable attractions to Saba Marine Park is the abundance of fishes at all the dive sites. There is an excellent representation of different species of fish that are common to the Caribbean. This can be attributed in part to the fact that relatively little fishing occurs around the Marine Park. The few Saban residents, who do fish in the SMP, do so mostly for their own personal consumption. One can easily see this by the amount of grouper species (large groupers, graysby, hind and coney) that inhabit these waters. The grouper species are usually the first to have a noticeable decline when an area is heavily fished and their population has been drastically reduced in the rest of the Caribbean and particularly in the Lesser Antilles.
- The Saba Bank provides one of the few study sites of coral reef ecosystems that are not –or minimally- affected by land-based sources of pollution and by impacts of coastal development in general.

Threats to marine ecosystems and resources:

The bank:

- Over-fishing, in particular of conch and lobster.
- Oil transshipment facility on St. Eustatius.
- Frequent anchoring of tankers.
- Slight possibility of continued oil and gas exploration.

MANAGEMENT STATUS AND ISSUES:

The park has four types of zones, including a no take zone. The private sector has been involved with conservation and the Marine Park in several ways. Prior to the establishment of the Park they placed moorings at the most frequently visited dive sites and they had an informal "zoning" agreement with the local fishermen whereby certain popular dive sites were not fished. They have shared their boats and dive equipment with the park manager and they provided labor and services during mooring installation. They submit visitor statistics and fees collected to the park manager on a monthly basis and they play an important role in preventing and reporting violations of the Marine Environment Ordinance and in reporting maintenance needs of the mooring system.

Park visitors have generally commented favorably on the achievements of the Marine Park and many find the so-called "dollar-a-dive" park fee low. Partly as a result of these comments the local Government has approved a doubling of the park fees earlier this year. Although Saba is definitely not a yachting destination, its fame as a diver destination has caused a rapid increase in the number of

yachts bringing in divers and snorkelers. The park's mooring system is highly popular with visiting yachts, but since it is intended for limited use only (diving and snorkeling), overnight moorings are now being placed in the designated anchorages and all yachts will be required to pay a mooring/anchoring fee.

The Park is managed on behalf of the Government by a local NGO, the Saba Conservation Foundation, and has a staff of two assisted by a small number of volunteers. The revenue generated by the Park from visitor fees, souvenir sales and donations ("Friends of the Saba Marine Park") covers at present 70% of the total budget, with the deficit being covered by a Government subsidy to the Saba Conservation Foundation. Although park visitation did not increase over the last two years as expected, the Saba Marine Park is still anticipating to become fully self-financing within the next two to three years.
The requirement to pay visitor fees directly to the Marine Park as well as to provide accurate dive statistics was linked to a special Marine Park license for dive operators. These licenses serve two purposes: they provide a control mechanisms in case growth of the industry needs to be limited and they enable the Government to set standards for safety and quality of the services rendered by the operators and to revoke or suspend permits of operators who do not adhere to those standards or do not comply with any of the Marine Park regulations. It was left to the operators whether or not to charge the marine park fee to their clients, but it was suggested the users be made aware of this contribution to the Park. The report published in 1995 'Integrating economic, environmental and social issues in an evaluation of the Saba Marine Park' by Leanne Fernandes (1995, see www.sabapark.com), concludes that the Saban community largely agrees about what should be the most important objective of the management, i.e. achieving ecological sustainability and environmental quality, bringing economic benefits to Saba, managing the park in a social acceptable manner and providing an international site for learning about marine biology and management using the Saba Marine Park as a model.
The island has many part-time fishermen, and although they do not depend on fishing for their livelihood they are not different from fishermen in general in that they do not like to be restricted in their freedom. Key elements in obtaining their support were the ability to demonstrate compensatory benefits and the willingness to compromise on controversial issues.
Over 6000 divers visit the Saba Marine Park every year and like many neighboring islands, reef-related tourism is now the main source of income. Collection of any kind of dead or living organisms found in the Saba Marine Park is not allowed. But corals are easily broken by trampling when people walk out of the reef; snorkelers and divers may kill polyps simply by touching coral colonies; and anchors and ship groundings can destroy large areas of reef. The careful management of the reefs by the Saba Marine Park plays a major role in their protection. The park philosophy is that sustainable eco-tourism can promote and assist the island development. The park has installed mooring buoys for their use by dive-boats and yacht in order to prevent anchor damage. The park has educational and information programs to increase public awareness.

In 1995, Rainald Framheim produced the report 'The value of nature protection, Economic analysis of the Saba Marine Park'. This report identifies the use of the Park as beneficial for the island economy generating $2 million directly and $3 million total income (Framheim, 1995), in other words the use of the park is generating 20% of the Saban economy.

In the bank, there are not protected areas, only fisheries regulations . They include gear limits, size limits for conch and lobster, ban on catch of berried and molting lobsters, complete ban on catch of sea turtles and mammals. Management is the joint responsibility of the Central Government of the Netherlands Antilles and the Island Government of Saba. A Fisheries Commission decides on issuing of fishing licenses. Enforcement is carried out by the Coast Guard. Lack of data and information management is the single most important limitation for the management of the fisheries resources in the bank. Lack of resources to conduct research and resource surveys (a complicating factor is that The Netherlands Antilles do not qualify for support from most bilateral and multilateral donors). The framework for environmental legislation is strong. However, the application of the framework in the bank at the level of the Island Governments is fairly weak.

EXISTENCE OF ENVIRONMENTAL MONITORING:

The park has ongoing monitoring programs of reef status (AGRRA, CARICOMP)

In the bank, a one-year monitoring of lobster and snapper catches was conducted with funding from the Central Government. The program has not (yet) been continued by the Island Government.

The amount of impact caused by divers has been determined since 1992 and is now incorporated in the management plan.

CONSTRAINTS FOR NOMINATION:

- There is no protected area established in the bank

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PROPOSED NAME OF THE SITE: Archipelago Los Roques National Park (map)

COUNTRIES: Venezuela

TYPE OF SITE: new site; coastal, marine, and small islands components

GEOGRAPHIC POSITION RELATIVE TO:

- Marine Province and Ecoregion: Tropical Northwestern Atlantic province, Central Caribbean marine ecoregion
- Ocean currents: upstream of the ecoregion

DESCRIPTION:

The proposed site comprises the Archipelago Los Roques National Park. This is the most outstanding representation of coral reef-seagrass-island mangrove complex of the Caribbean coast of South America. It is a unique nature area in the Caribbean due to the presence of a variety of tropical ecosystem (coral reefs, seagrass beds and mangroves) and the high conservation status of water quality, biodiversity and marine resources. The park is located 160km north off La Guaira (north central coast of Venezuela), between 11°12' and 12° 09' N, and between 66° 32' and 61° 00' W (221 120 ha). The park has 213 220 ha and is composed of a coralline archipelago of 50 islands, islets and keys; 200 sandy shoals, and numerous coral reef formations: patch and barrier reefs. The eastern barrier reef also known as "Cabecera de Los Roques" or "Gran Arrecifal del Este" stretches along 24.6-km, the southern one ("Gran Barrera del Sur") 36km long. Coral reefs and islands surround an oval central shallow lagoon (5m average depth) that is similar to the coral atolls of the Pacific. Mangrove cays and hypersaline lagoons are numerous and seagrass meadows are extensive. The park is part of the Offshore Venezuelan Islands coastal system of the Central Caribbean Marine Ecoregion and was classified as a "mixed" type (together with other 9 out of the 51 coastal systems delineated along the ecoregion coast) (Sullivan Sealey and Bustamante, 1999) due to its great variety and extension of marine ecosystems.

The proposed site meet the following criteria:

- It is an outstanding example of significant geomorphic or physiographic features (atoll- shape coral reef);
- It is an outstanding example of on-going ecological and biological processes in the evolution and development of terrestrial, freshwater, coastal and marine ecosystems and communities of plants and animals;
- Contains areas of exceptional natural beauty and aesthetic importance;
- Contains the most important, and conserved coral reef-seagrass-mangrove complex of the South America Caribbean coastal
- Harbors significant populations of threatened species such as groupers and queen conch and so are likely sources or larvae for

downstream areas in the Caribbean; as well as sea turtles and seabirds.

- Submerged cultural value (major shipwrecks and native archeological sites)

CONSERVATION STATUS:

The park has been a RAMSAR site since 1996 and meet criteria 1a, (2a) and 3b (see UNEP-WCMC overview paper) with several wetland types (A, B, C, G, H, (I), J (see UNEP-WCMC discussion paper).

Due to its remoteness, the area is relatively highly conserved in comparison with other coral reef areas of the South America Caribbean coast. Despite the threats to coral reefs being estimated as low to medium by Bryant *et al.* (1998) and Sullivan Sealey and Bustamante (1999), the queen conch illegal fishing and the unregulated coastal development may pose some threats to its natural value (biodiversity) and resources.

MANAGEMENT STATUS AND ISSUES:

The Archipelago de Los Roques National Park was established in 1972 and is the oldest marine park in the Caribbean. The park management plan ("reglamento de ordenamiento y uso") was established in 1991, and includes a zoning scheme with areas of integrated protection, recreational areas, research areas, and others. Lobster fishing is regulated (by seasonal closures and fishing gear restrictions) and the queen conch fishery is entirely closed. The park is managed by governmental agencies (Instituto Nacional de Parques and Autoridad Unica de Area, under the Ministry of Environment). The private organization Fundación Cientifica Los Roques contributes to the park management through the implementation of conservation, research, and education projects in the park area since 1963.

The major limitations for park management are enforcement and environmental monitoring due to lack of financial resources.

EXISTENCE OF ENVIRONMENTAL MONITORING:

There are some joint research and monitoring efforts by Fundación Científica Los Roques, Instituto Nacional de Parques, and the Simon Bolivar University (fisheries resources, queen conch populations, coral reef communities, sea turtle nesting).

CONSTRAINTS FOR NOMINATION:

The government of Venezuela is reluctant to nominate Heritage Sites.

PROPOSED NAME OF THE SITE: Jaragua National Park (map)

COUNTRY(S): Dominican Republic

TYPE OF SITE: new (recently submitted for nomination by the government); with terrestrial, marine and coastal and small island components, potentially transborder

GEOGRAPHIC POSITION RELATIVE TO:

- Marine Province and Ecoregion: Tropical Northwestern Atlantic province, Central Caribbean marine ecoregion
- Ocean currents: downstream of Puerto Rico and U.S. Virgin Islands

DESCRIPTION:

Southwestern Dominican Republic, Pedernales Province. Geographic coordinates, 17° 28' N to 17° 58' N and 71° 16' W to 71° 44' W.. With of 137 400 hectares (of which 36 900 are terrestrial) Jaragua is the second largest park in Dominican Republic.

GEOLOGICAL AND BIODIVERSITY VALUES (modified from the D.R government proposal to WHS Program):

Natural criteria:

i – Jaragua National Park and its buffer zone constitute one of the remaining areas of pristine Antillean wildlands, particularly those occurring in arid and coastal-marine ecosystems. The park sustains a unique sample of numerous ecosystems belonging to important biogeographic areas of Tropical Northwestern Atlantic, which historically has served as a center of terrestrial plant and animal speciation to the rest of the Caribbean. Twelve terrestrial vegetation associations have been described within Jaragua, as well as all coastal ecosystems such as sandy beaches, rocky shores, wetlands, seagrass beds, coral reefs and offshore islands and cays. The Park's terrestrial flora and fauna are unique, presenting high levels of endemism, both at the species and higher taxa levels. It is the only place in the Hispaniola island where the natural geographic distribution of several faunal groups overlaps, having all species of each taxa represented. Such is the case of the lizard genus *Ameiva*, and of the endemic colubrid snake *Uromacer*. There are also endemic species with very limited natural geographic ranges (*Anolis altavelensis, Pimenta haitiensis, Haitiella ekmanni*) within Jaragua. There are also numerous species of fisheries significance as well as critically endangered species, such as several reef fishes of the families Lutjanidae and Serranidae, the spiny lobster (*Panulirus argus*) and the hawksbill sea turtle (*Eretmochelys imbricata*). The invertebrate fauna is not well documented, but new species have been described in recent years.

ii – Jaragua National Park presents natural areas of unique scenic beauty. The Oviedo Lagoon, with it surrounding wetlands and inside cays is a spectacular place. Magnificent white-sand beaches such as Bahía de Las Aguilas and Trudillé, allow watching some of the most impressive sunsets. In a similar manner, the coastal wetlands offer incomparable views of wildfowl, and the steep rocky cliffs rising above a shallow turquoise sea in Beata and the mainland, offer a strikingly beautiful contrast.

iii – Jaragua National Park represents one of the most important and significant habitats for *in situ* conservation of Caribbean biodiversity. It represents the only portion of coastal marine lowlands of the "South Paleoisland" of Hispaniola under protection. Hispaniola was formed by two ancient islands, which were independently colonized by plant and animals, which underwent independent speciation processes. The ancient islands are known as the "North Paleoisland" and the "South Paleoisland".

Jaragua's natural physiography and dryness has represented a historic natural protection to the area, which has been strengthened after it was designated a National Park in 1983. This has allowed in the survival of important species of Antillean and Hispaniolan flora and fauna. Some of these are presently are considered as endangered or critically endangered by the IUCN's *Red List of Endangered Species*.

In Jaragua, there are important mangrove forests, as well as aromatic and medicinal plants. One of them, canelilla (*Pimenta haitiensis*), has a very limited natural distribution, being almost restricted to the park's area. Species with great potential for timber production and ornamental purposes have also been identified.

The Park serves as reserve for important relict populations of both native and endemic mammals. Some of these are under imminent danger of extinction, such as the hutía (*Plagiodontia aedium*) and the solenodon (*Soledonodon paradoxus*). In addition, Jaragua also serves as habitat to numerous species of native, endemic, and migratory birds. In fact, the island's largest population of the white-crowned pigeon (*Columba leucocephala*) and possibly of its entire Antillean range, forms enormous breeding colonies in the Park. Furthermore, Jaragua has the most important population of the plain pigeon (*Columba inornata*), an Antillean endangered species. In some of its offshore islands and cays breeds the largest known Caribbean colony of the sooty tern (*Sterna fuscata*).

Jaragua also harbors the most important population of the rhinoceros iguana (*Cyclura cornuta*) and supports a significant part of the remaining population of Ricord's Iguana (*Cyclura ricordi*), both critically endangered lizards. In addition, the also endangered and restricted turtle to the South Paleoisland, the elegant slider (*Trachemys decorata*) is found here.

Included within its marine ecosystems are the most extensive and best-preserved areas of seagrasses of Hispaniola, which at the same time support endangered and/or valuable fisheries species. Some of the best-preserved coral reefs of the insular Caribbean reefs, lie inside its boundaries.

Jaragua's seagrass areas serve as feeding grounds for queen conch (*Strombus gigas*), West Indian manatees (*Trichechus manatus manatus*), and green sea turtles (*Chelonia mydas*). In fact, the highest known aggregation of juvenile hawksbill turtles (*Eretmochelys imbricata*) has been recorded in the Park's area. Presently, all marine turtle species reported for Hispaniola, nest in Jaragua's beaches (*Eretmochelys imbricata, Chelonia mydas, Caretta caretta* and *Dermochelys coriacea*), representing a regionally important nesting ground for leatherbacks (*Dermochelys coriacea*). The land crab (*Cardisoma guanhumi*), the queen conch (*Strombus gigas*) and the spiny lobster (*Panulirus argus*), sustain important fisheries in the area with high economic and cultural significance

CONSERVATION STATUS:

Physical conditions, such as the Park's harsh geology, have naturally precluded the establishment of human settlements, along with the exuberant vegetation and the unsuitability of its soils for agricultural purposes. A number of small, abandoned agricultural plots exists, but in most, natural vegetation is successfully coming back. These small interventions do not affect in a significant way the integrity of the vegetation cover of this protected area. Fires are not frequent in the Park. For all of these reasons the vegetation cover is in a near-natural state of conservation, and no serious threats to it can be expected. Its terrestrial fauna is also highly conserved both in the forests and wetlands, since there are no human settlements, and no hunting activities have taken place for a long time.

As in most of they Insular Caribbean, the marine resources have declined over the last 30 years and reef fish, queen conch and lobster populations are significantly reduced. However, the area is considered the lest affected of the whole island.

The demand for these products has increased with the expansion of tourism in the country. But even so, the special structural characteristics and extension of the nursery areas in shallow-water ecosystems (reef, seagrass, mangrove), as well as the geographical location of the park, downstream from major larval dispersal areas in the island, have somehow contributed to lessen the impact of intensive harvesting over the species populations

Indicators of conservation conditions of the area include the breeding colony of sooty terns, which is the largest of the Caribbean; the densest aggregation of juvenile hawksbill turtles documented in the world; the largest existing population of the rhinoceros iguana. The frequent presence of marine mammals, especially of the endangered West Indian manatees could also serve as a conservation

indicator.

Jaragua National Park is in high conservation status and thus provides a unique opportunity for the study and enjoyment of Caribbean species, ecosystems, and landscapes.

In terms of uniqueness, the only property declared by UNESCO with major similarities, is the Guánica Biosphere Reserve, in southwest Puerto Rico. This Reserve protects an important sample of dry coastal forest. Although these areas share many floral and faunal species, Jaragua constitutes a much bigger and complex area. Jaragua has a total of 137 400 hectares (of which 36 900 are terrestrial), while Guánica only presents 4 015. In Jaragua, dominant forest species covering most parts are endemic and restricted to this area, such as the macaco palm (*Haitiella ekmanni*). Furthermore, Jaragua's fauna presents important levels of endemism, including critically endangered species, such as the rock iguanas (*Cyclura cornuta* and *C. ricordi*).

Other important facts that highlight the uniqueness of Jaragua, include its regionally important breeding colonies of sooty terns (*Sterna fuscata*) and white-crowned pigeons (*Columba leucocephala*), as well as the occurrence of the best-preserved populations of the rhinoceros iguana (*Cyclura cornuta*). Finally, the existence of some of the most impressive coral reef areas of the insular Caribbean which hold the largest studied aggregation of juvenile hawksbill turtles (*Eretmochelys imbricata*) in the world, also makes Jaragua a very unique and special place for nature conservation.

MANAGEMENT STATUS AND ISSUES:

There is national legislation that provides for its protected area status (recently revised as Law 64-00, or General Law of the Environment and Natural Resources).

The Under-Secretariat of Protected Areas and Biodiversity and its personnel on the Park's area create strict controls to the use of the existing flora and fauna. However, although the marine area of Jaragua is one of the two largest marine protected areas of southern Dominican Republic and the Hispaniola Is. (the other one is Parque Nacional del Este, in the mosteastern part of the island), fisheries regulations are insufficient, those existing are weakly enforced. For more than 10 years now, Grupo Jaragua, a national conservation NGO, has worked in the co-management of the Park in close association with government agencies, thus contributing to the integration of local communities to the management and protection of the Park.

Lack of financial resources and qualified park rangers are among the main problems facing the park management and protection effectiveness

EXISTENCE OF ENVIRONMENTAL MONITORING:

A permanent monitoring program on hawksbill turtle abundance (in the water and nesting individuals) and reef status is carried out since 1996 with the support of Bekko Japan Association, the hawksbill turtle survey program of Mona I. (Puerto Rico), the US Fish and Wildlife Foundation, and Grupo Jaragua (a local NGO). A current Global Environmental Facility (GEF) project is underway.

CONSTRAINTS FOR NOMINATION:

None is expected from the government of Dominican Republic which recently submitted its nomination

PROPOSED NAME OF THE SITE: Archipelago de los Canarreos (map)

COUNTRY(S): Cuba

TYPE OF SITE: new, with terrestrial, marine, coastal and small island components

GEOGRAPHIC POSITION RELATIVE TO:

- Marine Province and Ecoregion: Tropical northwestern Atlantic province, Central Caribbean marine ecoregion
- Ocean currents: downstream of the ecoregion; self-recruitment is likely due to the existence of a nearby ocean gyre; some contribution to downstream ecosystems (e.g. in South Florida) is suggested as well

DESCRIPTION:

The proposed site constitutes a cluster of different areas that are ecologically associated to each other, located in the Archipelago Canarrreos. The archipelago comprises hundred of keys and islets of different size. It is situated in the Gulf of Batabano which is limited to the north by the mainland (provinces of La Habana, Pinar del Rio and Matanzas) and by Los Indios and San Felipe Keys, the Isle of Youth, Bocas de Alonso and Campos Keys, and the Jardines and Jardinillos sub-archipelago along the west, south and east boundaries. A long reef tract fringes the shelf along the outer side of the keys and islands. The Gulf of Batabano, the water body where the Archipealgo Canarreos is located, is equivalent to 38% of the total emerged area of Cuba (in comparison with 64% for the total submarine shelf).

The attached map shows the proposed system of marine protected areas. Most of them are in the process of approval by the Cuban Assembly and are expected to be declared next year. The ones included in the proposed WHS are:

- National Parks- Guanahacabibes (MAB site), San Felipe, Punta Frances, Cayo Cantiles-Avalo-Rosario, and Cienaga de Zapata (a RAMSAR site that includes various terrestrial national parks within the Zapata Swamp as well as the adjacent keys, shallow-water habitats, and deep water bodies of Golfo de Cazones and Cochinos Bay);
- Fauna Refuges- Cayamas Keys, Punta Coco, Jagua Bank, and Juan Ruiz-Cristobal-Providencia keys;
- Ecological Reserves- Punta del Este (in Isla de la Juventud), Megano de Vizcaino Reef, and Cayo Largo, and
- Fisheries Reserves or No-take Areas:
    1. Ernest Thaelman Key –Located at 22°01'18" - 81°23'32 to 22°04' - 81°27'24" in the northeastern edge of the Gulf of Cazones; from the southern shore of the key to the 200 m isobath (19 km_). Highly developed reef formations with high

biodiversity; endangered species (black coral, ornamental reef fish species), extensive pristine beaches, and documented nursery areas for snappers.

2. Ensenada de Cazones. Located in the southern coast of the Matanzas province; includes the northern portion of the Gulf of Cazones, from a line stretching from the northern tip of Diego Pérez key (22°04'40" - 81°36') to Calvario key (22°05'36" - 81°29'), north to the mainland shore. The western boundary is located along the coast of the El Macio key, and the eastern limit is in a line stretching from Calvario Key to Cobo Key and along the western side of this key (22°09'15" - 81°27'36") to the mainland (22°11' - 81 27'36").
3. Approximate area: 165 km_. With an enclosed water circulation pattern, the northern part of the gulf of Cazones is a major area for larval recruitment of commercially important species (snappers, jacks, grunts, sea breams) generated in spawning sites located along the shelf edge to the south. The coral reefs in this area have a high species richness and abundance and conservation status. The protection includes reef fish spawning sites of overfished fish species (snappers, jacks, grunts) and sources of larvae for the fisheries grounds elsewhere in the gulf of Batabano.
4. Area surrounding the Juan Ruiz, Cristobal and Providencia keys. Located south of the Zapata Swamp. Limits: From Punta Cristobal (22°12' - 81°50'48") to the south to 22°51'24" - 81°50'48", and from here to 22°07'24" - 81°52 '36", and north to the mainland coast (22°16'48" - 81°52'36"). Approximate area: 185 km_. With extensive seagrass beds, abundant food supply for juveniles and few predators, it is a well-documented nursery area for commercial fish species such as lane and gray snappers, sea breams, and grunts.
5. Punta del Este- Cayo Hicacos (southeastern corner of Isla de la Juventud). Limits: in the south, the 200-m isobath, between a straight line running from the coast to offshore, at 82°33'24" and another stretching out from the east of Campos key (82°20'). The area stretches out from the eastern coast of Isla de la Juventud, to a shallow-water area sheltered by a string of keys and shoals (San Juan, Bocas de Alonso, Rabihorcado, Coco, Palma and Campos) along the east, northeast and north sides. It is a documented nursery area for reef fish and spiny lobster (the latter is a major fisheries resource in Cuba and is particularly abundant in the gulf of Batabano). Coral reefs and mangroves of high aesthetic value and high biodiversity harbor an abundant fish community. The reef slope is an important habitat for large-sized and highly fecund adult lobster individuals. The site also has historical value: pictographies made in the Punta del Este cave (a National Monument) by aborigines.
6. Punta Francés- Punta Pedernales (Isla de la Juventud). Limits: At 21°34'12" W, off Isla de la Juventud, east to the 200-m contour, and from Punta Francés (21°37'48" - 83°11'24") to the lighthouse Los Cayuelos (21°38'24" - 83°11'12") to the lighthouse Faro del Medio. Commercial fishing closure is already in place. An expansion of the area was proposed in

order to implement a comprehensive management plan. With high aesthetic and conservation value, the site includes one of the best conserved coral reefs of the Caribbean. Large-sized individuals of commercially important fishes are common here.

7. Reef slope from Cabo Francés in the western tip of Isla de la Juventud to Punta Francés, Pinar del Rio province (mainland). This comprises the 10-400-m depth range of the outer reef slope. Research data have shown that this is a major residential area for the reproductive stock of spiny lobster and so an important source of larvae that likely get retained in the adjacent oceanic gyre off the southern coast of Isla de la Juventud.
8. Ensenada de Corrientes (Pinar del Rio province). Limits: From the southern coast in Cabo Corrientes, close to the western tip of Cuba (84° 30' W) off the 200-m isobath, and from there along the outer edge of the shelf to 84°33'W (approximate area: 40 km_). This narrow shelf is well known as a major spawning area for groupers and snappers, and a likely source of larvae to the populations residing in the gulf of Batabano, due to the prevailing sea currents flowing to the east. The area includes fringing reefs with high conservation status and aesthetic value.

GEOLOGICAL AND BIODIVERSITY VALUES:

The Archipelago of Canarreos comprises the whole set of islands, keys, islets and banks located within the Gulf of Batabanó at the southwestern section of the Cuban shelf. This system is located between the 21º 25' and 22º 41' N and 80º 52' and 84º 00' W and has an area of 27 673 $km^{2,}$. The Gulf of Batabano is the largest and most habitat-diverse shelf area of Cuba and the insular Caribbean. The Gulf is a shallow body (3-6 m prevailing depths) surrounded by the main island in the north, and the Canarreos Archipelago (almost 700 hundred mangrove islets and keys and the Isle of Youth) in the west, south and northeastern part. The gulf is covered by extensive seagrass beds and sandy areas as well as numerous patch reefs; an array of islands and barrier reefs separates the gulf from the Caribbean Sea. Mangroves fringe the islands and mainland and are particularly extensive in the Zapata Swamp. All these conditions combine to provide highly diverse marine fauna and abundant populations of lobsters, seabirds, bottlenose dolphin, sea turtles, the Antillean manatee and numerous reef fish species.

The southeastern portion of the gulf shelf is covered by a unique environment: extensive sandy bottoms covered by extensive oolite sandy banks, which are the result of an intensive process of calcium carbonate precipitation. This is one of the four areas of the world where this process takes place (Nuñez Jiménez, 1984). Along the southern boundary, the Canarreos Archipelago is washed by oligrotrophic waters of the northern Caribbean Sea which are driven by tidal currents through the channels between keys and islands,

and dragged b y the prevailing trade winds from east to west. At the northeastern part of the gulf, the terrestrial runoff from mainland forms the largest wetland in the country: the Zapata Swamp (in the Zapata Peninsula). This area as well as the lowlands of southern Havana contributes a significant amount of freshwater, nutrients and sediments to the Gulf of Batabano and many of its islets and keys. Both influences (i.e. the oceanic waters of the Caribbean Sea from the south and east, and the freshwater input from the mainland) combine to shape the seasonal and spatial patterns of the hydrobiological conditions of the gulf. This physical scenario generates a diversified, patchy mosaic of seascapes with highly ecological and aesthetic value, and significant fisheries and tourism resources.

The karstic characteristics of the seafloor of this extensive "macrolagoon" are responsible of the existence of an extensive system of submarine caverns and blue holes. Some of the blue holes are situated in very shallow areas close to the Gulf of Cazones (a tongue of the ocean fringing the northeastern boundary of the Gulf of Batabano) and are deeper than 70m.

The fringing-barrier coral reef along the shelf edge is lengthy and almost continuous. It is the third largest in the Caribbean. Most of the islands (as big as 18-km long) are barrier reefs located as far as 100 km off the mainland coast. The shelf area is the largest of the insular Caribbean. Nonetheless, the terrestrial and marine ecosystems are intimately related as the hydrobiological conditions in the shallow-water areas are strongly influenced by the freshwater, nutrients and sediment input from upland.

Coral reef die offs have been notably low and the deterioration detected seems to be associated with hurricane, coral disease, and sea urchin die off. The most developed and healthy reefs are located close to the keys Hicacos, Campos, Cantiles, Blanco, Sigua, Diego Perez and Thaelmann and fringing the Gulf of Cazones.

Numerous types of shallow-water habitats have been identified in the area, such as 10 types of seagrass beds, two bare bottoms (no vegetation) almost, 4 rocky bottom types and one of consolidated soft bottom, with no vegetation. So far, 979 species of marine animals have been collected and deposited in natural collections, namely, 45 corals, 23 gorgonians, 137 sponges, 212 polychaetes, 108 mollusks, 63 crabs, 28 ascidians, 8 sea urchin, 5 asteroidean and 258 fishes. Some emblematic species are found in the region such as the crocodile *Crocodylus rhombifer*) and the Antillean manatee *Trichechus manatus* which inhabit the wetlands and nearshore areas of the proposed area. Some, such as the green turtle (*Caretta caretta*) and the hawksbill turtle (*Eretmochelys imbricata*), nest in the beaches of the Canarreos Archipelago.

The reproductive strategies of the reef fishes (snappers and groupers, mainly) and the presence of nursery areas make this area an

important source of larvae to downstream areas.

Three different major mangrove formations are found in the site and they comprise the greatest of the country and the largest of the insular Caribbean (mangrove trees can get 10-m tall).

(see biodiversity values of the proposed fisheries reserves above)

CONSERVATION STATUS: (SEE ABOVE)

MANAGEMENT STATUS AND ISSUES:

Most of the protected areas included in the proposed cluster WH site are in the process of being approved by the government, and have no management plan yet. Only the Fisheries Reserves (no-take areas) and the Refuges of Fauna or Flora and Fauna (see map) are already established. The number of MPAs is still low in comparison with the terrestrial areas, and there are still some controversial issues regarding fishing closures and the management of areas with great tourism potential. Diving and recreational boating regulations are weak or not sufficiently enforced due to the remoteness of some areas and lack of resources. There is still some discussion within the relevant agencies on the benefits of fisheries reserves for conservation and its usefulness in fisheries resources management. Lack of financial resources does not allow for the taking of full advantage of the relatively high knowledge on the ecology and the status of populations and fisheries resources, as well as the professional capacity and commitment to conservation of the scientific and conservation community in Cuba. Although conservation NGOs are practically non-existent (there are some small environmental groups with very little impact in the planning and decision making processes) numerous highly qualified professionals and the very nature of the fisheries and tourism industry in Cuba (mostly state owned) may favor the implementation and enforcement of MPA legislation when approved and properly funded. The potential funding source of donors from the limited but growing business sector (foreign investors and tour operators) has not been sufficiently exploited. The implementation of conservation projects jointly with US conservation NGOs has been very limited due to political issues despite enormous potential. The number and scope of international projects (funded by GEF, UNDP, UNESCO, WWF) are both insufficient.

EXISTENCE OF ENVIRONMENTAL MONITORING:

The Gulf of Batabano is the most studied marine area in Cuba. There is a wealth of scientific information on the geological setting, the hydrological (both physical and chemical oceanography) seasonal and spatial patterns, the life history of species populations (reef

fishes, shrimp and lobster), and the species composition, distribution, zonation and ecological structure of biological communities (in mangrove, coral reef and seagrass habitats). This information has been used in the current planning process and in contributing significantly to the current effort of siting and delineating MPAs and a nation-wide system.
CONSTRAINTS FOR NOMINATION: Most protected areas are not legally established yet, but are expected to be approved late next year**.**

PROPOSED NAME OF THE SITE: U.S.V.I System (pending)
COUNTRY(S): United States Virgin Islands, U.S.A.
TYPE OF SITE: new; with terrestrial, coastal, marine and small island components; cluster
GEOGRAPHIC POSITION RELATIVE TO: · Marine Province and Ecoregion: Tropical Northwestern Atlantic province; Lesser Antilles marine ecoregion. · Ocean currents: upstream of Puerto Rico and Dominican Republic, downstream of the eastern Caribbean islands.
DESCRIPTION:
GEOLOGICAL AND BIODIVERSITY VALUES: **Species and populations** **Outstanding geological features and critical habitats**
CONSERVATION STATUS:
MANAGEMENT STATUS AND ISSUES:
EXISTENCE OF ENVIRONMENTAL MONITORING:
CONSTRAINTS FOR NOMINATION: .

Table 3 shows the criteria met for all the sites proposed in this document. The most difficult WHS criterion to evaluate is no. 7 ("sites significantly large enough to maintain the integrity and sustainability of the marine system and species populations"). The assessment of this factor, essential for evaluating the ecological integrity of the site, requires scientific knowledge of the temporal and spatial patterns biological connectivity of the local populations with the nearby areas ("horizontal interconnectivity"), i.e. the general spatial and temporal patterns of larvae dispersal and recruitment. In addition, the relationship between upstream freshwater ecosystems and the coastal ecosystems ("vertical connectivity") is also important to understand the land-sea linkages. This information is very limited in most cases as local circulation patterns that retain larvae and the home range of populations are unclear for most species and in most areas. In addition, most MPAs are small and isolated as many were established for recreational purposes (marine parks). Climate change and the downsizing of marine populations due to overharvesting and habitat deterioration provide additional uncertainty on how big and how many should be the protected areas for an effective biodiversity protection. That is the reason that drove the team of marine scientists that participated in the prioritization exercise led by The Nature Conservancy for the Central Caribbean marine ecoregion to define the "coastal system" (a geographic unit larger that an MPA) as the smallest area for effective conservation. That is conservations scientists and planners look at the development of national marine park systems or transboundary networks of MPAs -as well as the terrestrial-marine protection corridors- as the only way to provide effective protection to coastal biodiversity. The current project aiming at expanding the area of the existing WHS and promoting the nomination of new ones may contribute significantly to foster the establishment of new protected areas (marine and terrestrial) and the strengthening of the effectiveness of those that exist but are not effective in conserving the marine and small island biodiversity.

The data provided in Table 3 is an attempt to evaluate the feasibility of the proposed sites to be successful as WHS, based on the local institutional capacity for management, stewardship and research, the level of knowledge of the site (e.g. ecological, environmental quality)

and the attention that the sites attracts. I hope this table stimulates a productive discussion among the project participants and serves as a guideline for IUCN and the WHS program to build the strategy for the process of nomination of the candidate sites.

Table 2 Criteria met by the proposed WHS of marine, coastal and small island natural value and factors affecting their feasibility (based on best data available)

No.	Proposed site (new or expansion of an existing)	Meet natural criteria [a]	Feasibility factors				
			Institutional capacity for management, stewardship and research (H, M, L)	Level of knowledge of ecosystems (H, M, L)	Local attention (H, M, L)	Government attention (H, M, L)	International attention (H, M. L)
1	Cocos Island Biosphere Reserve	i, ii, iii, iv, 1, 2, 3, 4, 5, 6, 7	L	L	H	H	M
2	Belize Barrier Reef	i, ii, iii, iv, 1, 2, 3, 4,	L	L	H	H	H

	System	5, 6, 7					
3	Yucatan Reefs (including Sian “Ka’an Biosphere Reserve)	i, ii, iii, iv, 1, 2, 3, 4, 5, 6, 7	H	H	H	H	H
4	Fernando de Noronha and Atol das Rocas	i, ii, iii, iii, 1, 3, 4, 5, 6, 7	L	L	L	M	L
5	Maranhao entrances and lagoons	i, ii, iii, iv, 1, 2, 3, 4, 5, 6, 7	L	L	L	L	L
6	Andros Is.	i, ii, iii, 1, 2, 3, 4, 5, 6, 7	M	L	H	H	H

7	Exumas Land and Sea Park	iii, iv, 1, 2, 3, 6, 7	M	M	H	H	H
8	Saba Island and Bank	i, ii, iii, iv, 1, 2, 3, 4, 5, 6, 7	H	M	H	H	H
9	Archipelago Los Roques National Park	I, ii, iii, iv, 1, 2, 3, 4, 5, 6	M	L	M	L	L
10	Jaragua National Park	i, ii, iii, iv, 1, 2, 3, 4, 5, 6	M	M	H	H	L
11	Archipelago Canarreos	i, ii, iii, iv, 1, 2, 3, 4, 5, 6, 7	M	H	L	H	L
12	U.S. V. I. Parks	i, ii, iii, iv, 1, 2, 3, 4,	L	M	H	H	L

	Systems	5, 6					

[a] General criteria for natural heritage sites

i. Be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;
ii. Be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, freshwater, coastal and marine ecosystems and communities of plants and animals;
iii. Containing superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance; or
iv. Containing the most important and significant natural habitats for in situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

Specific criteria for tropical marine coastal and small island sites condition of integrity

1. Important as congregating, breeding and feeding grounds (invertebrates, fish, sea turtles and other reptiles, birds, and marine mammals)
2. Of regional or global importance with regards to the geographic distribution of natural populations (including position relative to sea currents).
3. With high biological diversity (species and habitats).
4. Sites important for rare, vulnerable or endangered flora and fauna.
5. Containing specialized habitats (e.g. wetlands, islands, estuaries, mangrove forests, coral reefs, upwelling)
6. In a state containing of naturalness, large and unfragmented assemblages.
7. Sites significantly large to maintain the integrity and sustainability of the marine system and species populations

Appendix 1 Geographic coverage of the tropical and subtropical Coastal Biogeographic Provinces and Marine Ecoregions as defined in Sullivan Sealey and Bustamante (1999)

PROVINCE: Ecoregions	**Geographic limits**	**Countries included**	**Total area (km^2)**	**Total shelf area to 200m depth (km^2)**	**Mangrove area (km^2)**	**WHS,** *MAB*; RAMSAR sites
TROPICAL EASTERN PACIFIC:	Northern limit: from a line stretching out of Cabo San Lucas (Baja California) to Cabo Corrientes (Jalisco), in Mexico, to Illescas Peninsula (Peru)	México, Guatemala, El Salvador, Nicaragua, Costa Rica, Panamá, Colombia, Ecuador, Perú	3 372 702			
Clipperton and Revillagigedo Islands	Oceanic atoll and island group	Mexico	1 035 466	502	0	

Mexican Tropical Pacific	From the entrance of the Gulf of California and the northernmost influence of the North Equatorial Current south to the southern extent of the narrow shelf where starts the gulf of Tehuantepec (Mexico).	México	767 409	12 144	1510	La Encrucijada, Marismas Nacionales (México)
Chiapas-Nicaragua	Shelf widens up at the northern part of the Gulf of Tehuantepec, coastal plains dominate the coastline; southern limit at the Gulf of Papagayo (11’30°)	México, Guatemala, El Salvador, Honduras, Nicaragua and Costa Rica)	392 204	84 893	7306	Machon-Guachumal (Guatemala)
Nicoya	From the Gulf of Papagayo, Costa Rica (11°30’N) to the Azuero Peninsula, Panama (80°30’ W)	Costa Rica and Panama	330 360	26 242	2100	**Area de Conservación Guanacaste (Costa Rica);** Tamarindo, Terraba-Sierpe (Costa Rica), Golfo de Montijo (Panama),
Cocos Island	Oceanic island of volcanic origin	Costa Rica	864 646	43	some	**National Park and Biological Reserve Isla del Coco**

Panama Bight	From Azuero Peninsula (Costa Rica) to Caráquez Bay (Ecuador),	Costa Rica, Panama, Colombia, Ecuador	508 357	54 996	8719	**Darien National Park,** Punta Patino (both in Panama),
Guayaquil	From Caráquez Bay (Ecuador) to Illescas Peninsula (Peru), which comprises the Guayaquil Gulf and its vicinity, and extends to the southernmost extent of the influence of tropical waters flowing southwards and of mangroves forests.	Ecuador, Peru	263 411	31 035	3 727	Machalilla National Park (Ecuador)
GALÁPAGOS ISLANDS	Galápagos Archipelago 960km west of the continental coast	Ecuador	9,119	0		**Galapagos Marine Reserve**
TROPICAL SOUTHWESTERN ATLANTIC:	From the Brazil-Guyana border (4°N) south to Cabo Frio (23° S)	Brazil	2 999 950	533 244		

Amazonian	Northern limit: 4°N, southern limit: 3°S. Influenced by northerly –flowing warm Guiana Current, and the Amazon river discharge	Brazil	556 062	287 516	23 661	Reentrancias Maranhennses Environmental Protection Area (Brazil)
Northeastern Brazil	Northern limit: Parnaiba river (3°S), southern limit: Salvador (13°S), including Atoll das Rocas and Fernando de Noronha Islands	Brazil	1 043 712	74 082	3940	**Nominated but recently postponed: Fernando de Noronha Marine National Park and Das Rocas Atoll (Brazil)**
Sao Pedro and Sao Paulo Islands	At 1°N	Brazil	465 415	7	0	
Eastern Brazil	From Salvador, Bahia state (13°S to Cabo Frio (23°S)	Brazil	497 583	99 667	3215	**Discovery Coast (Brazil)**
Trindade and Martin Vaz Islands	At about 20°30’	Brazil	437 177	21	0	

TROPICAL NORTHWESTERN ATLANTIC:	Also known as the wider Caribbean: from Palm Beach, South Florida and the Gulf of Mexico south to the Guyana-Brazil border, including the Bahamas, and the Greater and Lesser Antilles	U.S., the insular Caribbean, Central America, Colombia and Venezuela (see ecoregions for countries' names)	5 738 557	1 080 631		
Gulf of Mexico	From the Mexico-US border along the coast of Mexico to Cabo Catoche (northeastern corner of Yucatan Peninsula), including the Florida Flower Garden Banks and Middle Grounds, north to Tampa Bay, both in the U.S.	México, U.S.	1 186 745	336 407	12 170	

South Florida	From south to north from Dry Tortugas, along the Florida Keys and South Florida to Palm Beach, Florida, including the Florida Bay and the Florida Keys	U.S.	23 600			**Everglades National Park**
Bahamian Archipelago	The Bahamas, and Turk and Caicos Is., and La Plata, Mouchoir and Navidad Banks.	The Bahamas, Turk and Caicos Islands, Dominican Republic	855 017	123 274	6299	Inagua National Park

Central Caribbean	From Cuba and Mexico (Caribbean coast) along the continental coast south to the Venezuela-Guyana border, and Trinidad and Tobago, including the Greater Antilles and Cayman Is.	U.S., Puerto Rico; Cuba; Dominican Republic, Haiti; Jamaica; Mexico, Cayman Is.; Aruba; Curacao and Bonaire; Trinidad and Tobago; Venezuela; Colombia; Belice; Guatemala; Honduras; Nicaragua; Costa Rica and Panama	2 654 945	422 470	38 969	**Belize Barrier Reef System, Sian Ka'an Biosphere Reserve** (Mexico), **Rio Platano Biosphere Reserve** (Honduras), **Desembarco del Granma National Park** (Cuba); **Darien National Park**; nominated but not inscribed: **National Park Medanos del Coro** (Venezuela); *Buenavista, Baconao, Cienaga de Zapata, Cuchillas de Toa,* and *Peninsula de Guanahacabibes* (Cuba); *La Amistad* (Panama); *Guanica* (Puerto Rico), *USVI (US); Cienaga Grande de Santa Marta*, and *Seaflower* (Colombia) Sistema Delta Estuarino del Rio Magdalena- Cienaga Grande de Santa Marta (Colombia), Archipielago Los Roques, Parque Nacional Medanos del Coro, Cuare, La Tacarigua, and Laguna La Restinga (Venezuela); Gandoca-Manzanillo, Tamarindo and Terraba-Sierpe; National Park Jeantte Kawas, Punta Izopo, Barras Cuero y Salado (Honduras); San San-Pond Sak (Costa Rica)

Lesser Antilles	From Culebra Is. (Puerto Rico) east and southeast to Grenada	Puerto Rico, U.S. Virgin Islands, British Virgin Islands, Anguilla, Antigua and Barbuda, St. Kitts-Nevis, French St. Maarteen, St. Barthelemy; Montserrat, Guadeloupe, Dominica, Martinique, St. Lucia, St. Vincent and the Grenadines, Barbados, Grenada, Windward Netherland Antilles (St. Marteen, Saba, St. Eustatius).	655 092	28 568	314	*U.S. V.I.* (U.S.); Gran Cul-de-Sac Marin (Guadaloupe)
Guianan	From the Guyana-Venezuela border to the French Guiana-Brazil border	Guyana, Surinam, French Guiana	384 566	147 820	7067	Coppernamemonding (Suriname)

[a] after the UNEP-WCMC overview paper

List of Figures and Tables

Maps of proposed sites